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A RIVER, A REGION AND A RESEARCH PROBLEM

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IWR REPORT 71-6

A RIVER, A REGION AND A RESEARCH PROBLEM

A Report Submitted to the

U.S. Army Engineer Institute for Water Resources
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Alexandria, Virginia 22314

directed by

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FOREWORD

A. Purpose.

It is evident that completed water resource projects stimulate economic activity and can have significant social, political and environmental consequences as well. Given a means for interpreting the data, one should be able to measure these effects qualitatively and/or quantitatively through analysis of data carefully collected over a period of time. Such expost evaluations should throw light on the role of natural resource development as a catalyst for change and on the community development process itself; but more importantly they should provide for the development of enhanced predictive techniques for Corps planners. Expost evaluations are exceedingly difficult, involving problems in selecting proper parameters, determining extent of area to be studied, determining time and timing of observations and isolating what changes would take place "with" the project from those that would take place "without" the project. There is little precedent for such evaluations in the water resources field.

This research, under the direction of Charles L. Leven and R. B. Read. Institute for Urban and Regional Studies, Washington University, St. Louis, was undertaken to develop theoretical framework for assessing the broad economic, social, political and environmental effects of the McClellan-Kerr Arkansas River Multiple Purpose Project. This project has been selected by the IWR and the Southwestern Division of the Corps for a mutually conducted, broad expost evaluation study. Leven et. al., have previously developed a methodology under contract with the Corps (IWR

Report 69-1) for assessing developmental benefits of water resources investments. In the new contract Leven et. al., were to improve this methodology through use of regional linear programming and outline its application to the Arkansas project. Through use of an interdisciplinary team Leven et. al., were also to develop means for evaluating social, economic and environmental effects. As a corollary they were to articulate additional research which might be required to insure success of the expost evaluation.

B. Findings.

The report presents a methodology for projecting the efficient location of water related industry via a regional linear programming model. It utilizes a spatial general equilibrium approach, and provides a mechanism for separating conditions "with" the project and "without" the project based on local project conditions.

Other methodologies for analyzing social, political and environmental impacts are proposed utilizing the general equilibrium framework. Possible parameters for observation are indicated as appropriate to the study area.

C. Assessment.

The economic model is considered feasible. The authors have overcome the previously intractable model problem of isolating "with" and "without" conditions. They have greatly improved the technique for predicting locations of water-related activities with respect to the economic characteristics of a region in terms of operation of the model and reduced data requirements. The procedures developed will, however, still require a substantial investment for data and analysis. It is anticipated that with experience in use of the model, these requirements can be reduced for application to different project locations.

The authors' extensive use of multi-disciplinary seminars was productive in that a rich variety of approaches is advanced and a broad, inclusive framework developed for consideration of the social, political and environmental impacts. However, the state of the art for implementing the analytical framework which integrate the social, political and environmental impacts with economic impacts is much less advanced. The authors itemize future research to help overcome this handicap.

D. Status.

The results of this study and other research findings will now be applied by the IWR and the Southwestern Division to the expost evaluation of the McClellan-Kerr Arkansas River Multiple Purpose Project, which will involve collection of data for five or ten years and which will experiment with predictive techniques. Within the framework of the general equilibrium approach there will be limited experimentation with social, political and environmental data and probably there will be further research aimed at developing these specific experiments.

This report represents the findings, conclusions and independent judgment of the team of researchers. Their conclusions are not to be construed to necessarily represent the view of the Corps of Engineers. Policy and procedural changes which may result from this research will be implemented by directives and guidelines provided by the Chief of Engineers through command channels.

PREFACE

The work reported on in this volume essentially could be characterized as a somewhat ambitious preresearch effort of a highly experimental nature.

The problem was to lay out the kind of research effort which should be undertaken by the Corps of Army Engineers if they are to "learn" from the experience of the Arkansas River Development Project. This learning involves two aspects. First, there is a desire simply to know what effects the project will have had in the future, partly as a guide to encouraging more effective utilization of it and partly as a check on the preproject analysis of expected benefits. Even more important is the possibility, through a comprehensive study of the consequences of the ARDP, of feeding into the design of future large scale projects some of the experiences on the Arkansas.

As ambitious as such an undertaking would be even in a conventional framework, it is made even more challenging in the present situation by the desire to look into not only economic impacts, but consequences of the project for social structure and well-being, political organization and behavior, and characteristics of the natural environment as well.

In essence, it is the interdisciplinary nature of this work which has made it both complicated and time consuming. Ordinarily a research prospectus is drawn up by a single person who is both familiar with what has been done in the past and is himself experienced in research on a particular class of impact. In this case, however, it would seem that no such "person" exists who has sufficiently intimate experience over the wide variety of disciplines represented. The obvious solution, of course, is to pick a group of people from different disciplines to prepare such a prospectus, as it were by committee. The major work input, however, is the long gestation period which is required before such a collection of individuals can work as a group. The early months of the project--which in total involved about a year--were devoted to numerous meetings and to the assembly of background materials which were circulated to various researchers involved. As time progressed our seminars became more formalized, frequently involving outside experts as speakers and frequently attended by one or more representatives of the Corps of Engineers. After that stage came several months of more individualized work, with frequent contacts among ourselves, but mainly with each of us working in our own areas within a total framework that we all understood and agreed to and using language as free of disciplinary jargon as possible.

These later stages of the project produced numerous reports and manuscripts by various individuals and the materials contained in those papers and reports formed the major basis for the material in this report. In particular, substantial portions of draft manuscripts were prepared by John Bennett, David Felix, Donald MacDonald, Norma Brown, Honoria Niehaus, John Gist and Robert Evans. We, of course, must assume the responsibility for the reorganization and redrafting of the materials in their papers plus the drafting of additional sections of our own in completing the present report. In that specific phase of the project, that is the drafting of this report, we are especially grateful to Norma Brown who provided advice and judgment as well as preparing a good deal of additional draft material on environmental impacts. We would also like to acknowledge the help of John Bennett, John Goering and David Felix in providing many useful suggestions in this final phase. The bibliography was prepared by Sophie Korczyk with assistance by Nancy Edwards.

A number of individuals served as research assistants at various phases of the project including Michael Unger, Margaret Thomas, Sharon De Sha, Donna Smith, John Wenninger, Margaret Jess and Doris Gregory.

A number of individuals were active in project seminars and we would especially like to acknowledge the participation of James Buzzell, Washington University; John Baden, Indiana University; Russell R. Dynes, Ohio State University; M. Taghi Farvar, Washington University; David Gates, Missouri Botanical Gardens; John Goering, Washington University; Leslie Mack, Water Consultant for the Governor of Arkansas; Leon Moses, Northwestern University; John H. Peterson, Arkansas Planning Commission; D. K. Rice, University of Arkansas; and Robert Salisbury, Washington University.

We would like to express our thanks for the high degree of cooperation which we received from a number of people in the Corps of Engineers. Special thanks are due to Richard Howes, Nathaniel Back, Edgar Landenberger, Ivan Hobson, and Robert Summitt. We also received a great deal of cooperation from a great many people in the states of Arkansas and Oklahoma, both in public agencies and private life. They simply are too numerous to mention, but we would like to note the high degree of cooperation obtained. It certainly points to an expectation of good cooperation in any future research efforts which may evolve from this report.

Finally, very special thanks are due Mrs. Emma Williams who served as secretary on the project. This not only involved extensive typing of manuscripts and keeping of records, but also the coordination of a very complicated effort.

As can be seen from the foregoing a considerable number of people from a variety of disciplines were involved and their contributions were substantial indeed. In essence, we do hope that we have created a truly interdisciplinary document, although we must bear final responsibility for its content.

C.L.L.

R.B.R.

St. Louis, Missouri

March 1971.

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PART I

INTRODUCTION

The purpose of this report is to lay out the major dimensions of a research plan for engaging in long-run study of the impact of a major river basin improvement on the region in which it is located. In particular, it is concerned with the question of how to determine, essentially after the fact, what the impact of the Arkansas River development plan will have been on the functioning of societal and environmental processes in the Arkansas River Basin.

Only incidentally will this report discuss the actual impacts which might already have been felt in the construction of the project (which has been about completed in fiscal year 1970) or the likely impacts on the region that might be expected in the future as the project facilities come into full use. Rather, it is directed at describing the kind of research effort that would be needed to know what difference the presence of the project in fact will have made in the Arkansas Basin.

It should be noted that this report is not directed at trying to find a research plan for evaluating whether the project should or should not have been built. In point of fact, the project does now exist and the intent here is to lay out a research program that will make it possible to learn more rather than less about the impacts of the project on the functioning of the region, primarily as a guide to future basin and water shed development project formulation.

It is also not the primary intent of this report either to predict the future of the Arkansas River Basin, or even to recommend the research that would be needed to make such predictions. True, various trends in the Basin will have to be taken into account in so far as identifying relevant research issues is concerned and even, to some extent, in selecting the most appropriate kinds of research methodology. Accordingly, various projections for the area will appear in the report, but only as a guide to our research recommendations.

Perhaps the essence of what we are trying to capture in this report can be more easily understood in the context of a consideration of the question, "what would the Tennessee Valley really have been like in 1970 without the TVA?" Obviously, we can determine the current magnitude of many, if not most, of the relevant welfare related magnitudes for the Tennessee Valley (things like population, employment, per capita income, level of education, pollution levels, etc.), and we could probably find records of the magnitudes of most of these items in the mid-30s, before the TVA project had been undertaken. But simply looking at the difference between these magnitudes would not really tell us what were the impacts of the project. For example, even among those activities or populations which directly utilized TVA services, much less other activities and populations in the region, to what extent would they have located in the Tennessee Valley anyway even without the project? In short, everything that uses electricity cannot be put into the category of something that would not have existed in the Valley without TVA.

On the other hand, a variety of activities and populations which on the surface might seem to have no direct connection with TVA programs might nonetheless be very much affected by the program indirectly through a complex of economic or demographic linkages with more directly affected activities. Making at least crude estimates of the magnitudes of such interrelationships is something for which analytical techniques have been devised, at least in the case of a number of economic magnitudes, and to some extent with respect to sociological, political, or environmental characteristics as well. But in order to make such estimates of impact it is necessary to analyze particular changes in the context of the complex economic (or social or environmental) situation prevailing at the time that changes occur.

In the case of TVA it is now almost certainly too late to reassemble the historical record that would be needed for careful impact analysis. For example, it would be extremely difficult even to reconstruct the record of changing capacity or employment in a particular industry in the Tennessee Valley, say, in the late '40s. Other kinds of data would be even harder to come by. But even if this kind of information could be assembled, there would be the problem of relating the observed changes to TVA facilities. What we no longer know or really can reassemble today (actually, for the most part it was never assembled in the first place) is information on production costs in that industry in the Tennessee Valley as compared with other major producing areas, the cost of facilities there as opposed to other locations, the regional distribution of markets, or such information about costs, demand and location alternatives as might have been contained in the judgment of the people making the decision.

Without such information real analysis is not possible and it simply cannot be reassembled in proper form long after the fact. But in the Arkansas Valley it is not too late to plan for this kind of analytical surveillance. In fact, the very intention of this report is to suggest research methodologies and data collection efforts that can be established <u>now</u> so that <u>over time</u> we can learn progressively more and more about how the ARDP really will have affected the functioning of the Arkansas River Valley.

It should be noted that what we have in mind is not a "before" study, where before the fact we are trying to estimate what the impacts of a project will be. This kind of a study effort, with which we are quite familiar, is very useful as an aid to deciding on whether or not a project should be undertaken, but it does not really tell us what will actually happen to an area since there are far too many uncertainties about future developments which cannot be taken into account in the advance plan of study. Accordingly, as valuable as such studies might be in providing criteria for project selection, we really cannot learn what we should do "next time" by looking at the project study report, say, on the Delaware River. In order to learn how to design better projects we would have to see how completed projects actually have worked out.

But we really are not dealing with an "after" study either, that is where we would look at a region after all (or most) of the effects could be presumed to have been "worked out". As already noted, more is involved than simply chalking up the difference between a region's characteristics after all effects have been worked out and its characteristics prior to the construction of the project. The problem, of course, is that too many extraneous events would have occurred in the meantime. In the case of TVA, as indicated above the total historical change would reflect not only the building of TVA but also the installation of atomic energy facilities at Oak Ridge, the development of more competitive nearby locations in Arkansas, through reaggressive industrial financing activities there, etc.

Thus, what we are aiming at is a real "with-without" study. That is, we hope to develop a method of research where, by monitoring events as they occur, we will be able to say what the region might really have been like with all the historical events that actually did occur, whether anticipated or unanticipated at the time of the project decision, but without the project itself.

The first major difference, then, between the kind of research we are trying to describe here and what has been done traditionally is that we are aiming at a true "with-without" analysis. We are not, in other words, thinking about a simple "before-after" framework, of the kind that is ordinarily applied in project studies prior to their authorization, where in essence all that is studied is the marginal difference that the project would be expected to make assuming that no other changes would occur in the environment. In contrast, here we are attempting to find out what difference the project actually did make in the context of the actual historical situation in which it developed.

It should be added, of course, that we are not undertaking the design of research to estimate "with-without" effects in advance (this would require knowing other exogenous historical events in advance) but only to identify the actual project effects either after the fact or contemporaneous with it.

Even if this were the only departure from traditional methodologies, the research challenge would be a substantial one. But the research program described in this report departs from tradition in a second fundamental way, namely that it provides for the consideration of a wide variety of "noneconomic" impacts as well as economic ones. Specifically, the research program which we are aiming at should provide for a surveillance not only of economic, but of sociological, political, and environmental change in the region as well, together with the design of such analyses and methodologies as would be necessary to determine the extent to which change in these characteristics could be attributed to the development of the river. Just which aspects of sociological, political and environmental characteristics of the region could and should be singled out for study will be discussed in detail in subsequent chapters.

A third distinction between the research design reported here and a more traditional approach is that in addition to a wider range of analytical "outputs" (social, political, etc., as well as economic) we are interested in a somewhat wider range of analytical "inputs". This and the foregoing difference in the scope of the analysis is illustrated in the comparison between Figure 1-1 and 1-2.

Traditionally, most economic impact studies take project characteristics as specific as given and then proceed to estimate economic consequences. For example, starting with an assumption of some specified recreational reservoir capacity--ordinarily specified in terms of such things as miles of shoreline, capacity of beaches, number of pleasure boat moorings, etc.--the impact study would attempt to estimate recreation user-day demand and the impact of such recreational use on business activity. In a different situation, they might try to analyze the benefits from reduction from flood damage, with the reduction in flooding simply specified as the expected reduction in average annual flood stage or the reduction in the expected number of acres annually to be flooded. Or, in the case of analyzing the impacts of an increase in municipal and industrial water supply on industrial development, the analysis would generally take the increase in annual average and minimum stream flows as the starting point of the analysis.

But clearly the impact of a particular project characteristic might well depend not only on the physical nature of that characteristic, but on the circumstances under which the project came into being as well. At an early stage in the project we considered a variety of project attributes in addition to its simply physical characteristics as potentially relevant to the evaluation of project impact. These included: how the decision to install the

Figure 1-1

Format of a Typical Project Evaluation Study

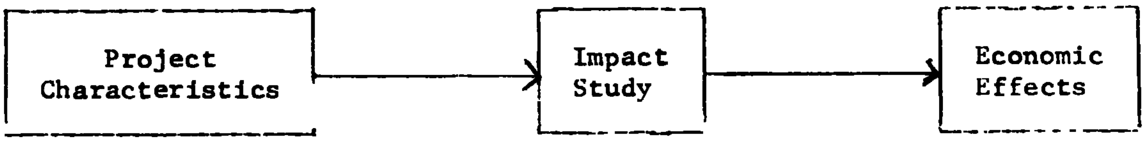
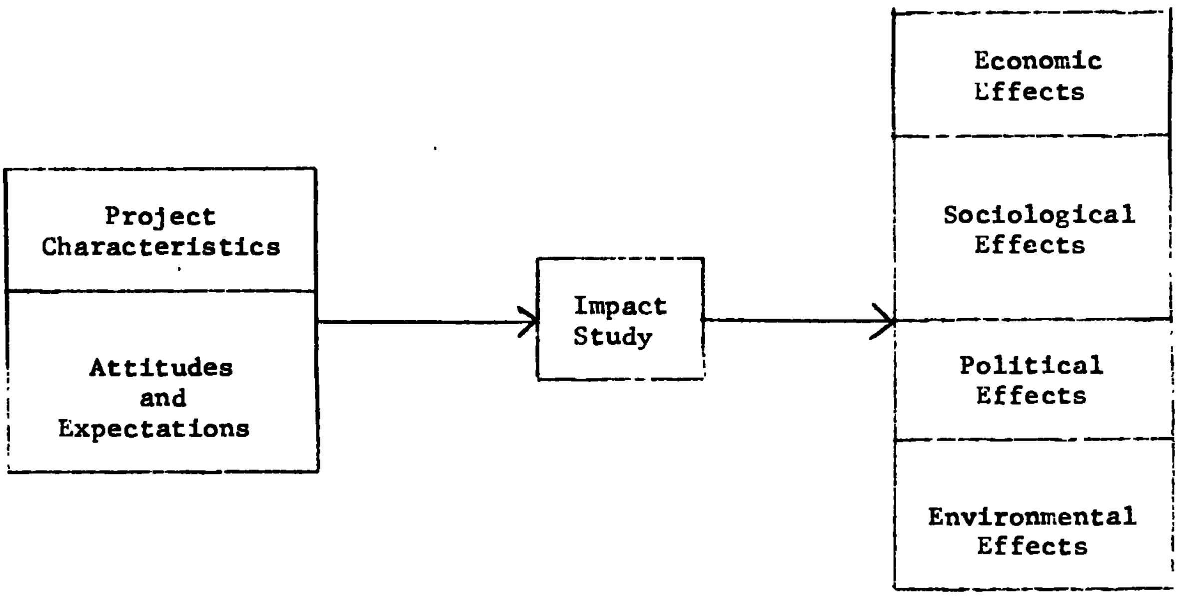


Figure 1-2

Format for an Expanded "With-Without" Study



project was made; how the project was to be financed; what were the attitudes and expectations of potentially effected individuals; and what was the nature of the engineering technology employed to achieve the particular physical results called for.

In terms of field work which was carried out, however, it became clear that such matters as who decided that the project ought to be built, what kind of argument was made for it in the Congress, how were the costs to be shared, etc. really could not be separated out as identifiable influences separate from the general attitudes and expectations of concerned individuals. Accordingly, it was decided that they could be subsumed under that latter heading. We do feel, however, that it is important to monitor such attitudes and expectations as a factor influencing impacts, independently of the project characteristics themselves.

At least in the case of the ARDP for example, it does seem that the impact of improved navigation will depend not only on the navigation capability of the river system itself, but also on what individuals believe that the impact of the navigation will be. For example, on the one hand if they are generally pessimistic about possible impacts, little planning or provision for industrial districts or favorable port locations will be made and in fact somewhat less industrial development than might have been expected may well occur. On the other hand, with highly optimistic expectations important ancillary capital facilities may be installed in advance of development thus increasing the "pull" of navigation more than might otherwise be the case.

Engineering considerations were also tentatively regarded as having a potential impact on project effects. What we had in mind here was taking cognizance of the fact that there are, in principle, a variety of ways of constructing a nine foot channel, and depending on which technology was employed, the results might well be different. On closer investigation it appears that the range of engineering possibilities really is not sufficiently great to make a material difference in navigation standards, and hence economic impacts, or probably on social or political impacts as well. The engineering might well make some real difference in biological or hydrological impacts, but even here since the ARDP contains only one "engineering solution" the opportunities for learning much about the relationships between engineering standards and environmental impacts would be extremely limited and so they were dropped from consideration as a separate factor of influence.

In reflecting on the difference between the traditional approach and the approach outlined here, one feature of Figure 1-2 should be noted, namely that we are not talking about four impact studies to separately trace out economic effects, then sociological effects, then political effects and then environmental effects. Rather, we have in mind a single impact study that simultaneously would trace out impacts over these four broad areas of concern.

As a practical matter, of course, a good bit of the actual research work in these four headings would be carried out more or less independently, by researchers having different skills and backgrounds. This is due, of course, mainly to the fact that analytical tools which we have to work with and much of the data comes to us in rather conventional "disciplinary" packages. We cannot expect to find economists who are especially knowledgeable about the microorganism structure of river systems, nor can we expect to find biologists who are very sensitive to the subtleties of discounting future benefits or identifying the indirect economic impacts. On the other hand, we do feel it is important for the various research elements to be carried out in a situation where there is frequent and close communication between the researchers from different disciplines so that feedback effects are not lost. For example, in projecting recreation user demand the economist should have access to analysis which might suggest that for environmental reasons the reservoir he is dealing with may become unsuitable for swimming. Similarly, the biologist may be importantly assisted in his work if he can avoid establishing water quality monitoring stations in reaches of the river which are likely to be substantially altered by major economic development.

So much for the general dimensions of the kind of research design that we are attempting to lay out. To make more specific recommendations about what kinds of studies ought to be undertaken and what kinds of data collected for the specific example selected--the Arkansas River Development Project--we will have to understand the river and the project on it and the region and its people. Accordingly, Part II of the report will discuss the nature of the Arkansas River and Part III will discuss the region and its people. Given this background, Part IV will discuss the recommended research program. This latter discussion will include not only an indication of the kinds of studies that ought to be undertaken, but will discuss in detail some of the problems that should be anticipated, both theoretical and empirical, in undertaking such research.

Any case study, no matter how detailed and extensive, can never be fully generalizable to other situations simply because every case is somewhat different. The fact that the research which we are outlining in this report is intended specifically for the Arkansas River Basin thus will necessarily limit applicability to other situations. These limitations will be discussed further in various sections of the report, but at the outset, it would seem desirable to set forth at least a few of the very broad general limitations which must be kept in mind.

An ideal case, of course, would be one where the project we were studying contained all of the characteristics and attributes that one might expect to find in any river development program and where the effected region would contain the full range of economic and social organization, of culture, of geography, and of natural environment that might be encountered anywhere in the United States. In this regard, one of the major limitations of research coming out of the study of the ARDP which must be recognized is that the project purposes are relatively narrow ones.

The great bulk of the project impacts which can be expected will occur from a single facet of it, namely that water transportation will become available from Tulsa (Catoosa) to the mouth of the Mississippi. Second in importance will be recreation facilities, but they would be very much smaller than the navigation impacts and probably would be pretty much confined to serving people in the general area of Oklahoma and Arkansas or perhaps some surrounding states: a major recreational resource having unique qualities and drawing importantly on the national demand for recreation is not part of the project.

Taken together, navigation and recreation would probably account for about 90% of the total project effect. The rest of the project would deal with electric power and flood control. The electric power component, however, is very small not only in relation to the project, but in relation to the total power supply of the effected region. While it might clearly have benefits of sufficient magnitude to justify the cost of the hydroelectric facilities installed these facilities are unlikely to have any noticeable developmental impact on the region. While they will supply a small increment to regional capacity at favorable cost, they would not really alter the general availability of electricity.

Flood control, embankment construction and water management features might have some impact on agricultural and/or timber production, but it would probably not be very great in terms of the total economy of the region. Insofar as increasing the supply of suitable flood-free sites is concerned, the effect clearly would be negligible. Finally--except for a certain amount of storage space allocated to water supply at Oologah, Keystone and Eufaula reservoirs--irrigation and domestic water supply do not figure in the project.

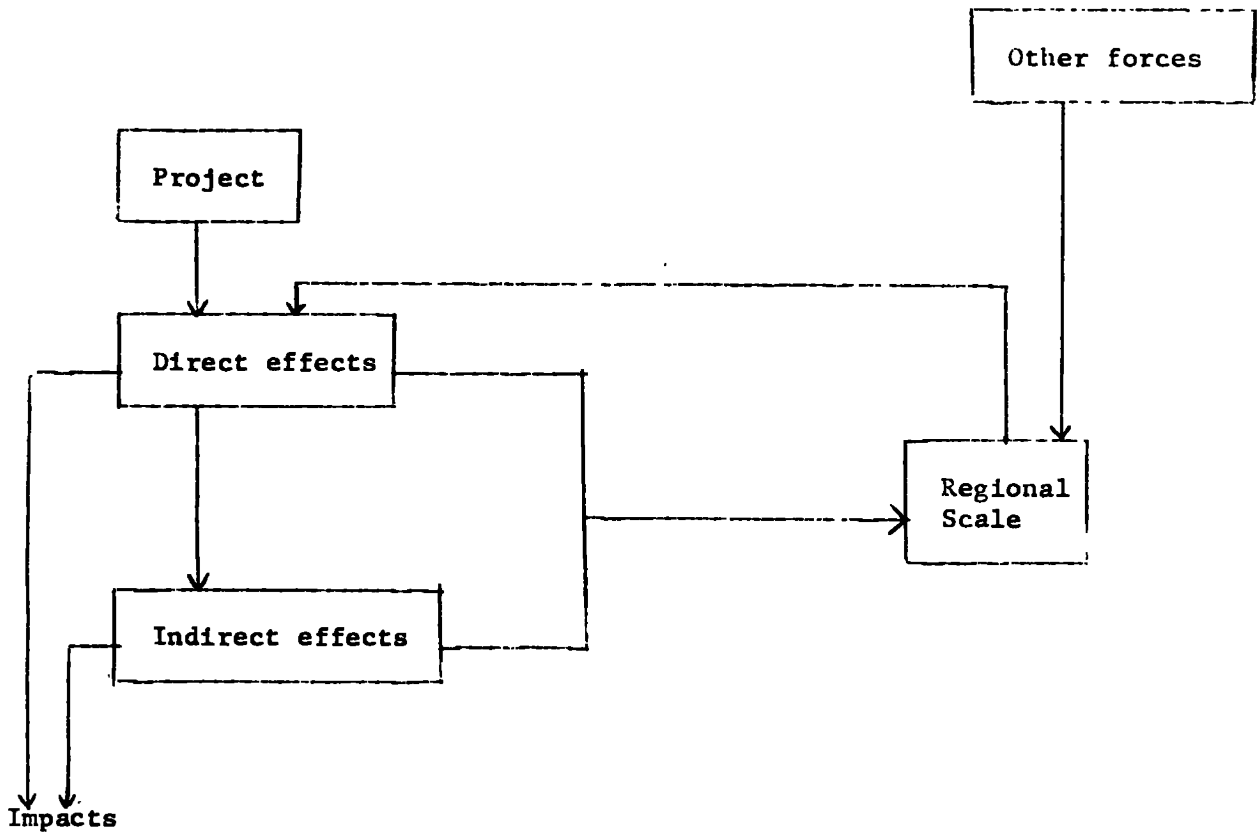
In short, then, there would be some difficulty in applying what we can learn from studying the Arkansas River to the design of a new river basin plan where provision of, say, municipal water supply and flood-free industrial sites were to be the major project components. On the other hand, while any case selected would similarly have idiosyncratic limitations, there certainly would be a wide variety of project design situations that would be wholly, or at least partly, coincident with the lessons we might learn from the Arkansas. Also, since this is to be the first river basin system to be studied on such a comprehensive basis, there may actually be some long-run methodological advantage in selecting a first case which is big in terms of scale but not unduly complicated in terms of its effects.

The region itself, too, is certainly not representative of the full range of situations which might be found on river basins throughout the United States. For example, the impacts of making barge transportation possible from Tulsa to the Mississippi would not necessarily be the same as the impacts that might be expected from creating a similar facility between Youngstown and Lake Erie. On the other hand, as will be seen in the main part of the report, the range of differences which can be found in the region is considerable. It contains at least one fairly large city, Tulsa, a number of medium size metropolitan areas, small towns, and fairly isolated rural settings. In addition, topography, rainfall and agricultural land utilization are subject to quite wide variations. However, while this environmental variation tends to make the Arkansas a very useful setting for a case study, the variation itself will complicate the research design. Specifically, hardly ever will it be possible to design research which talks about impacts on the Arkansas Basin in general, but rather in almost all cases it will be necessary to look at impacts separately for different sections of the river and different parts of the region.

As indicated above, it should be fairly easy to see that the applicability of research results would be somewhat limited by the fact that a particular project is to be studied in a particular region. There is an additional limitation on the research, however, which probably is not so obvious and which should be noted. It stems from the fact that the research which we have in mind is of a "with-without" nature; that it would be aimed at analyzing the actual changes which would have occurred in a region within the actual historical context of their occurrence. This presents what could be called a "factoring" problem which is illustrated in Figure 1-3. Specifically, how can we, after observing total changes in the region, determine what part, if any, was due to the ARDP and what part probably would have occurred anyway. For example, it is very likely that over the next decade there will be an increase in the

Figure 1-3

Scheme for Classifying Impacts



incidence of air pollution in the Arkansas Basin, simply because the area will become more urbanized. Moreover, it probably is the case that given the degree of increase in urbanization, crime and air pollution probably would be pretty much the same regardless of whether the urbanization was triggered by a navigation project or any other developmental event of equal consequence. And so, from an analytical standpoint, we are led into the more general problem of analyzing the impact of economic development as opposed to the narrower problem of strictly analyzing the impact of the improvement of a river system.

This "factoring" thus presents a thorny methodological problem. If we are to rule out of the analysis anything which cannot be tied directly to the river through some technological relationship with the characteristics of the river system we certainly would lose a good deal of the consequences. On the other hand, as was indicated in the discussion of the problem of studying TVA long after the fact, it makes no sense to talk about total change in the region as being the consequence of the river project. Thus, we must factor out that part of the total change which is river related.

Insofar as economic effects are concerned, even though some difficult theoretical problems and some rather formidable data collection efforts would be involved, it does appear practical at least as a research objective to achieve such separation within an analytical model. In short, at least an approximation to an operational general equilibrium framework probably can be constructed wherein we can "see" what is coming from the river improvement and what, presumably, must be coming from something else.

Also, in the case of environmental effects we probably can partially achieve this objective, mainly because there is within the biological sciences some formal understanding of the behavior of ecological systems and life cycles of organisms.

In regard to sociological and political effects, however, the problems of factoring are much more severe. In short, we really do not now have, nor in the near future are we likely to develop, detailed operational models of total system behavior. Here we will probably have to rely on a methodology which would consist mainly of monitoring, measuring and associating or comparing test and non-test areas. And even these will be difficult tasks. Much more will be said about these problems in the main part of the report, but it is important to keep such inherent difficulties in mind.

Finally, before proceeding to the body of the report, one final limitation ought at least to be noted. In starting out on the research underlying this report we were guided only by a directive that we should develop some research that would consider the broader "social, political, etc." and "environmental" consequences of river basin improvement. But this begs the question, of course, of what social or environmental consequences. It would have been very difficult to specify the relevant effects in advance for a variety of reasons. First, the whole research thrust itself is experimental and it is not clear which kinds of impacts would be important indicators of the region's wellbeing. Second, before a more thorough examination of the state of the art in the various disciplines involved and before considerable communication between people from various disciplines it was not really possible to determine what kinds of things were really researchable, even if they were of interest. Third, even where we might know the kinds of things we would be interested in and have an idea of their researchability from a theoretical point of view, there was still the problem of whether they would be important in the Arkansas

Basin and also whether in that area and in that project the relevant information could be obtained.

Accordingly, even though we believe that we have paved the way for a research effort that would make a real contribution to understanding the interaction between a major infrastructure investment and the functioning of a region, we cannot be thought of as having provided the last word on that subject. Some people surely will be interested in consequences we have not covered. In other cases the research difficulties involved may make it impractical to carry out certain aspects of the kinds of studies we have in mind. In any event, we do feel that this report contains more than enough material and suggested direction to make a very useful start on comprehensive with-without analysis of river basin improvement.

PART II

THE RIVER AND THE PROJECT

The river in its basin

The Arkansas River rises in the Sawatch Range, in central Colorado, at an east-west section of the continental divide known as Fremont Pass, and adjacent to the mining town of Climax. If you stop at the sign marking Fremont Pass and its altitude, and look south down the marshy slope, the ultimate origins--at least for literary purposes--of the River can be seen in the form of a tiny brook draining the snowbanks and a small glacier. From this point, the Arkansas plunges down the mountains, through the Royal Gorge, then passes east, with some meandering, through Colorado and Kansas, turns southeast in central Kansas and heads into Oklahoma, crossing the northeast section of the state. It then bisects Arkansas on a northwest-southeast line, flanking the Ozarks, and finally flows into the Mississippi in the eastern region of Arkansas known as the "Delta"--really part of the flat, humid Gulf coastal plain. The entire mileage covered is 1,450.

The drainage basin served by this river covers between 160,000 and 185,000 square miles (estimates differ) which is larger than that of the Mississippi. The basin has an average width of about 185 miles. Its major water volume is picked up in the Oklahoma-Arkansas region, as the streams draining the Ozark highlands, and a number of rivers draining the Oklahoma plains, join it. It is an important drainage channel for Ozark water, which means that the many small rivers providing recreational possibilities in the Ozarks are affected by control over the mainstream; hence development plans for the mainstream have had to take into account the entire drainage. The river has a total fall of 11,390 feet, ranging from 110 feet a mile near the source, to 0.4 feet a mile near the mouth. Precipitation in the basin averages around

25 inches a year in the mountains; 12.5 inches in eastern Colorado; 40 inches around Muskogee, Oklahoma; and 48 inches at Little Rock. The dryest strip is in western Kansas.

The river in Oklahoma receives the water of two groups of tributaries: the Verdigris, the Neosho, and some smaller rivers on the northeast, draining the Missouri Ozarks; and the Canadian, North Canadian, and the Deep Fork on the west and southwest, draining the central-western Oklahoma high plains. The ARDP has established dams in both sets of tributaries, creating a series of large, long lakes in the northeast, and one very large reservoir-lake, Eufaula, on the west--although the Eufaula lake, close to the mainstream, is really in the northeast corner of the state, along with the rest of the water. In Arkansas, the tributaries are smaller, but there are many more of them. Two longer tributaries in the Ouachitas, the Petit Jean and the Fourche La Fave rivers, come in from the west. These are large enough to have received dams, and contain the only two reservoir lakes on tributaries in the Arkansas section of the river. These two lakes, however, are small as compared with the huge impoundments in Oklahoma. The other two large Arkansas reservoirs are on the main stream.

Thus, by way of contrast, the ARDP region in Oklahoma is very compact and is bounded by a series of very large lake-reservoirs. In Arkansas, the ARDP is characterized by two mainstream reservoir lakes with quite small schemes on the tributaries. This suggests that in Oklahoma the project, in addition to its industrial stimulus, will have extensive impact from the recreation potential of the large lakes; but this effect will be less evident in Arkansas, where navigation and industry will probably be the primary factors.

<u>The river as a project</u>

The major economic use of the Arkansas River has been navigation, with boats using the river for transportation and haulage beginning in the 1820's. The chief problem of the Arkansas was its unpredictability--among the major rivers of the nation, the Arkansas has had the largest annual fluctuation in depth, which has meant water too low for navigation in the dry months, and severe flooding in the wet months, these cycles being relatively irregular and unpredictable.

Navigation improvements on the river were first authorized about 1832, the work by the Federal government consisting mainly of the removal of shoals and tree snags, and also works to prevent bank caving, another serious problem of this unpredictable river. Frustration generated by the fact that here was one of the longest rivers in America, but one with such difficulties for navigation that river towns could not depend on it for transportation and communication, and suffering constant danger from its floods, led to continual agitation for major controls, which finally materialized in the 20th century. Persistent advocacy of a major development scheme by senators and congressmen from Arkansas and Oklahoma, with particularly strong leadership provided by Sen. Robert S. Kerr, led to adoption of a series of development plans in the 1940's, with construction beginning after World War II. The Army Corps of Engineers was put in charge of the program. Details of chronology of the present project are presented later, but the main events were:

1943--Survey report "Arkansas River and Tributaries, Arkansas and Oklahoma," recommended multiple purpose plan.

1946--River and Harbor Act authorized the multiple purpose plan.

1950--Flood Control Act authorized Keystone in lieu of Mannford, Blackburn and Taft reservoirs. Also, construction started at Oologah.

1952--The Arkansas River Board completed an extensive four-year preliminary study and established criteria which were later used for preconstruction planning.

1954--The authorized project was restudied to determine if it should be classified "active" or "inactive." It was classified active.

1955--Work resumed at Oologah.

1956--Construction started on Keystone and Eufaula.

1963--Construction started on Lock and Dam No. 1 and Arkansas Post Canal. Completion of first stage of development of Oologah. Dedication of Oologah on July 20.

1964--Construction started on Ozark Lock and Dam, Robert S. Kerr Lock and Dam, and Locks and Dams Nos. 2, 3, 4, 5 and 7. Completion of Keystone, except for the powerhouse, scheduled for completion in 1967. Dedication of the Eufaula on September 25.

1965--Construction started on Webbers Falls Lock and Dam, and Locks and Dams Nos. 6, 8 and 9. Dedication of the Keystone on May 22.

1966--Construction started on Locks and Dam Nos. 13, 14, 17 and 18.

1967--Construction started at Dardanelle.

1968--Navigation up to Little Rock.

1969--Navigation up to Fort Smith.

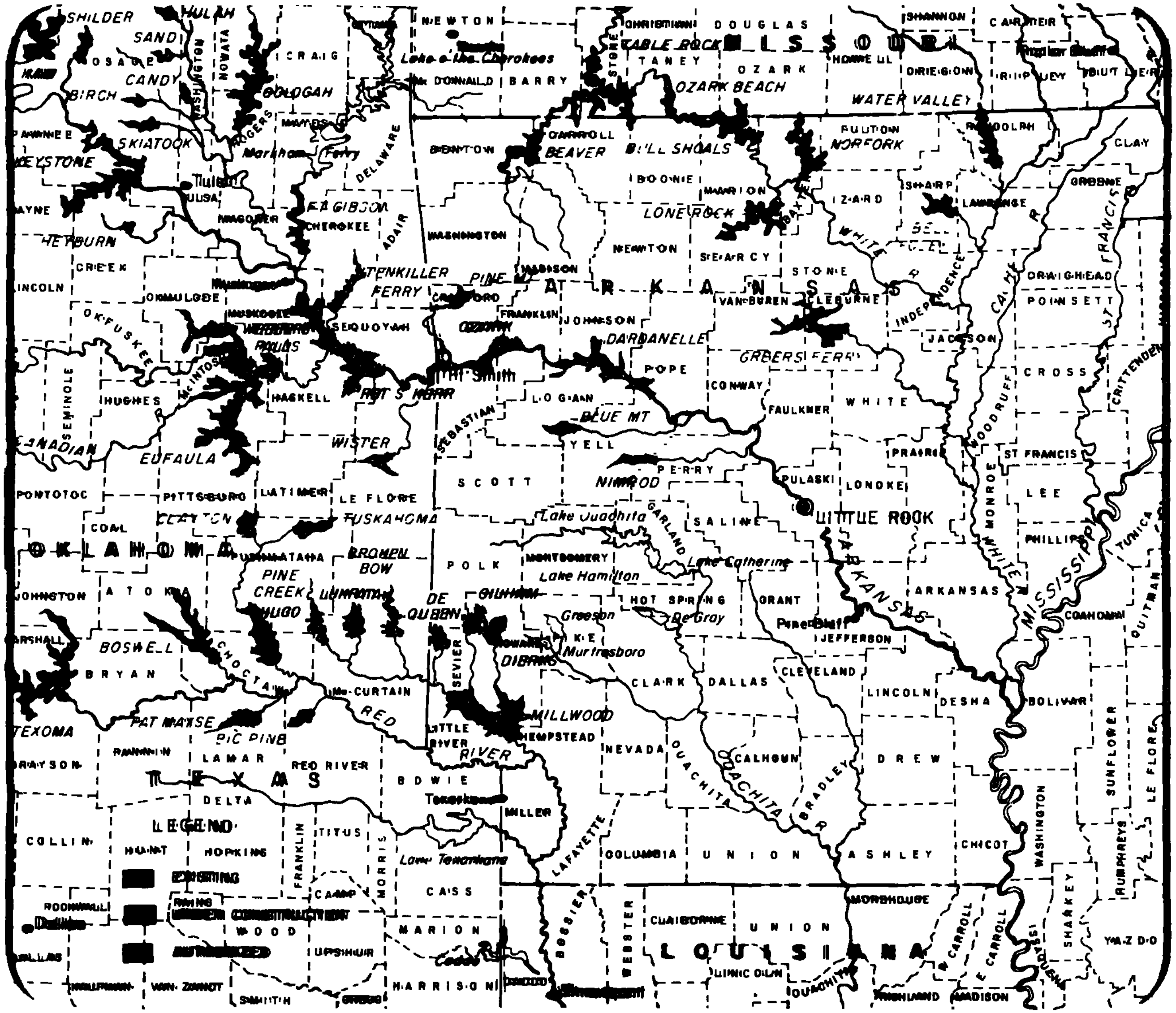
1970--Navigation up to Catoosa, Oklahoma, when the entire navigation project will be fully operational. Some work on power plants and recreational areas to be completed in 1971.

These facilities are located and identified in Figure 2-1.

The navigation channel of the "new" Arkansas River, at a minimum depth of nine feet, is 450 miles in length, a total which includes a 20-mile stretch preceding its junction with the Mississippi, where the meandering delta of the Arkansas is bypassed by the 9.2 miles of the Arkansas Post Canal and a terminal 9.8-mile stretch of the White River. The navigable channel then proceeds for 280 miles through Arkansas on the Arkansas River itself. The Oklahoma

Figure 2-1

Map of the Arkansas River Development Project



portion includes 100 miles on the Arkansas proper and 50 miles on the Verdigris River, a tributary.

Since the Oklahoma section traverses the northeast corner of the state, it includes the cities of Tulsa and Muskogee. To the north, the east and slightly to the west of these two cities lies Oklahoma's "Green Country"--that portion of the state with sufficient water to provide for perennial tree growth--actually a southwestward extension of the Missouri Ozark uplift. Most of the urban, industrial and water-related development in the state of Oklahoma has understandably been concentrated in this "green" northeast corner, a geographical concentration the ARDP can only intensify.

The project's regions

For the purposes of this study, 17 counties in this northeast corner of Oklahoma (out of the state's total of 76) have been designated as the "project region"--that is, the region of measurable impact of the ARDP, an area recommended for the contemplated ongoing study of the project's effect. It will be immediately noted that this represents a considerable expansion of the 7-county region of project impact officially designated by Oklahoma state agencies, whereas the 25-county impact region in Arkansas so recognized by Arkansas state officials has been accepted. Some words of explanation for our procedure would seem to be in order.

The official region of the Arkansas state planners is 2-3 counties deep on both sides of the river, whereas the Oklahoma analysts used a one-county unit. We consider the Arkansas analysis to be more realistic, since it acknowledges the wider dispersion of actual effect--as witness the cluster of counties in northeastern Oklahoma already affected by recreational developments on the tributaries (see narrative account immediately below). Consequently we made a considered selection of Oklahoma counties and enlarged our concept of the impact region from the officially designated 7 to the new total of 17--a move indicated by already apparent change, but one which we might have hesitated to make had the Oklahoma region been as intensively studied and documented by state agencies as the Arkansas region. On the contrary, however, analysis of the Oklahoma region must in any case be started almost from scratch, and so very little duplication or waste of effort is entailed in enlargement of the concept at this time. Impact regions in the two states are shown in Figures 2-2 and 2-3.

Activities already underscoring the concentration of effort in Oklahoma's northeast corner and the advisability of enlarging the impact region may be noted. Construction of river ports is in progress at Tulsa (Catoosa) and at Muskogee, with a resultant expected focusing of industrial effort in these cities, although the impetus will probably extend to Oklahoma City, only 100 miles down the Interstate from Tulsa. Development of the lakes created by dams on the tributaries has already resulted in the construction of more than 400 new cabins and other facilities each year since 1965. Some of the outlying cities, like Pryor, located northeast of Tulsa, are making efforts to entice industry away from the Tulsa nucleus. The booster spirit associated with the whole northeast Oklahoma effort is suggested by this typical passage from the Pryor promotional literature:

> The Magic Empire is a FOUR BILLION DOLLAR MARKET...and growing every month. Highest bank deposits in the state! Lakes in the Magic Empire have more miles of shoreline than the Atlantic Coast! This is truly a rich, responsive, and remarkable market![1]

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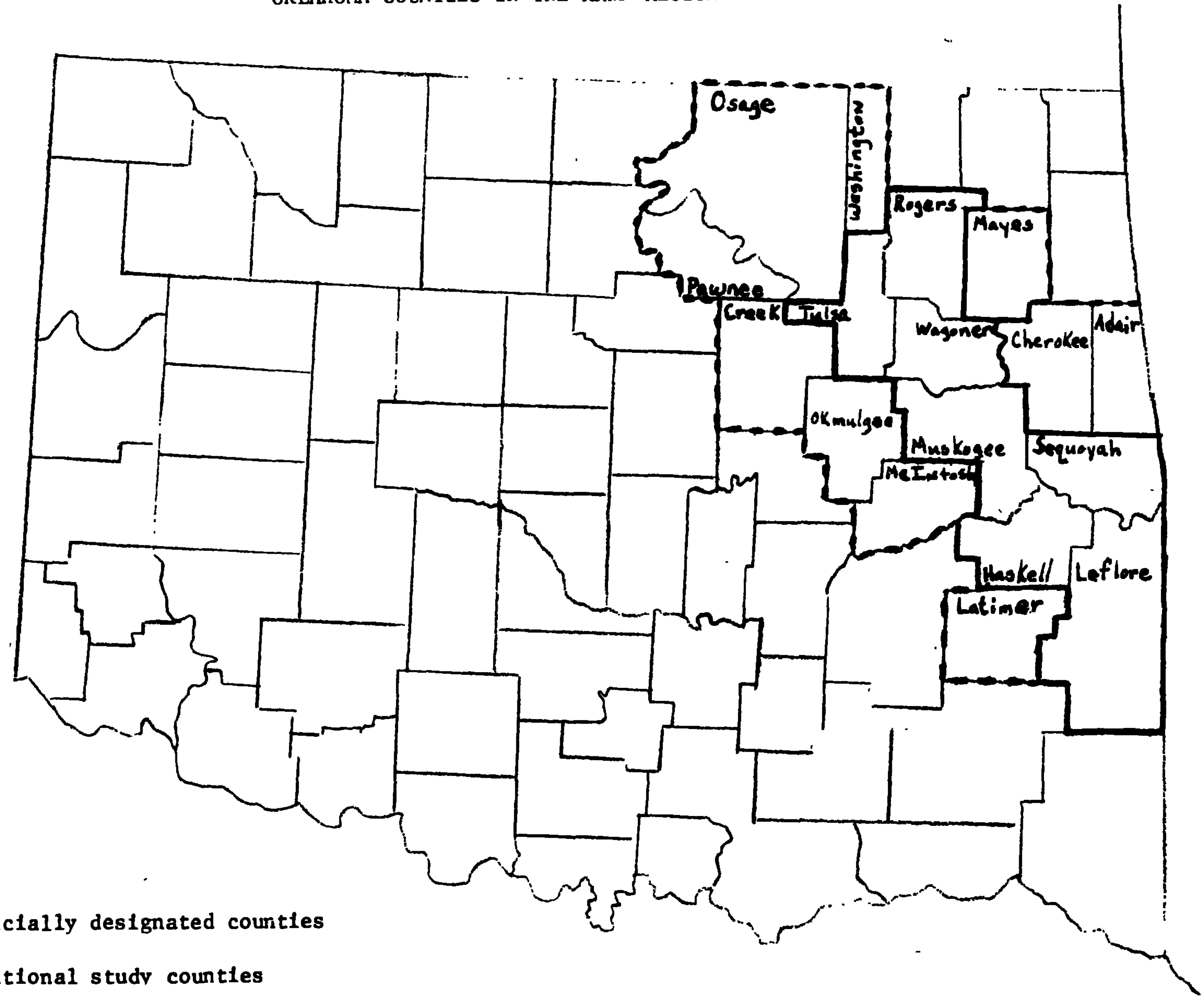
[1]See; "Mid-America Industrial District." Pryor, Oklahoma. (mimeographed book)

OKLAHOMA COUNTIES IN THE ARDP REGION



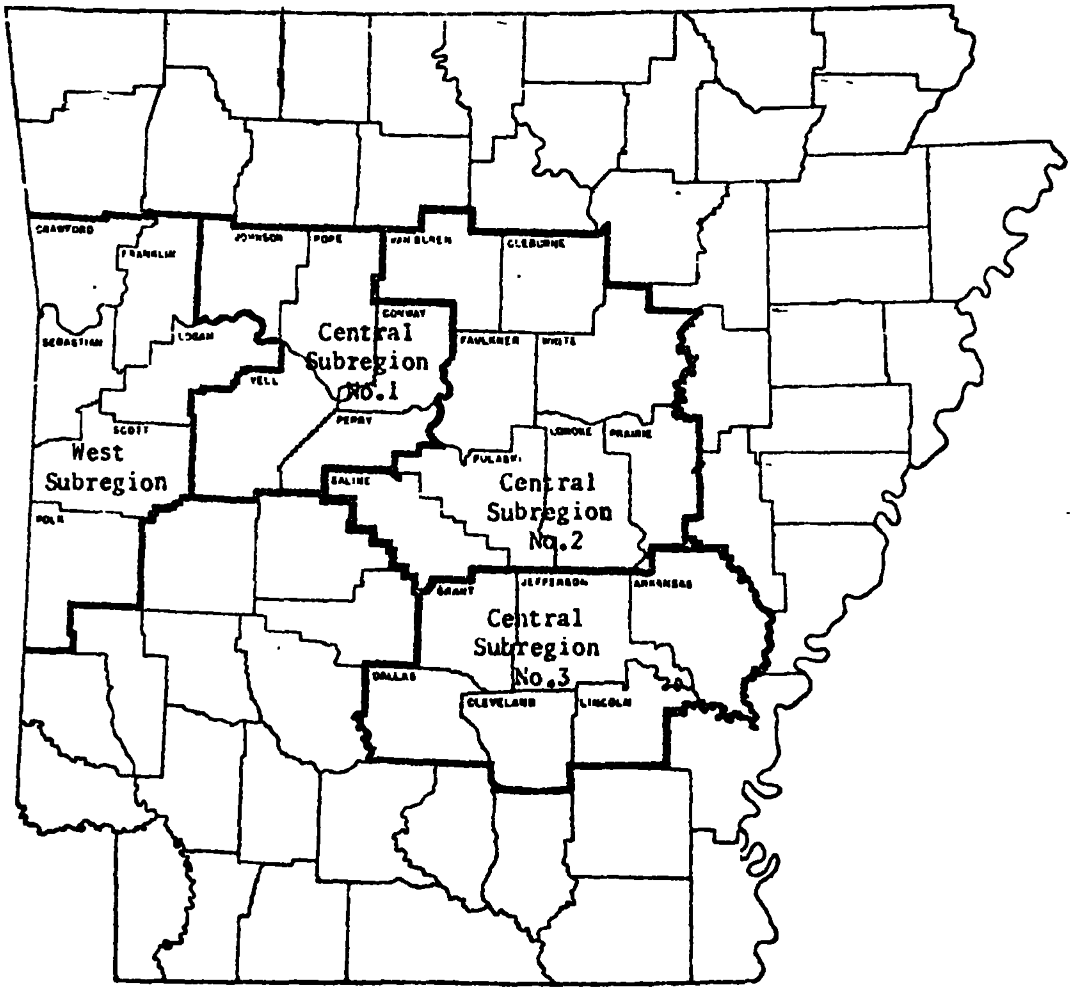
Officially designated counties

Additional study counties

Note: 3 Panhandle Counties not shown.

Figure 2-3

ARKANSAS COUNTIES IN THE ARDP REGION



The longest section of the Arkansas River flows through the state of Arkansas; the volume of water reaches its peak in that state; and the uses of the water are the most diversified, including agriculture as well as navigation and recreation. In any case, there is a fundamental difference between the states in terms of the geographic context in which the Arkansas River finds a place. In Arkansas, the major natural resource problem concerns the management of excess water; for Oklahoma, the major resource problem is the reverse, aridity.[1] About 12% of the area of Arkansas is under the influence of the Mississippi and its backwaters, and another 33% is influenced by the Arkansas. Essentially, the entire eastern half of the state is confronted with drainage problems of varying degrees of severity; and the area enclosed in the "V" formed as the Arkansas and Mississippi Rivers approach each other has been particularly subject to disastrous flooding.

As noted, the Arkansas River region of the state of Arkansas comprises 25 counties out of a total of 75, but this group does not constitute a homogeneous region, save for the common availability of river water, with its uses, promise, and problems. Approximately 19,000 square miles are included within these 25 counties, with one large city, greater Little Rock, and three smaller, Fort Smith, Russellville and Pine Bluff. The valley proper varies in width from 30 to 40 miles, and is a gently undulating plain about 300 to 600 feet above sea level, sloping toward the southeast, and containing a few prominent ridges and hills. Soils vary widely in the valley, as does practically every other aspect of the environment relevant for agriculture

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[1]See: Water: Oklahoma's No. 1 Problem. University Bureau of Water Resources Research, University of Oklahoma. Norman, 1961.

or other direct uses. Productivity of agriculture conforms to this variability in resources, the bottomlands having the highest productivity. Those counties where bottomland is most extensive (the eastern Delta) show the highest productivity values, as indicated in the following map (Fig. 2-4).

The extent and value of these lands sharpens our awareness that the river, both in its wild state and as a controlled system, presents a problem in relationships.

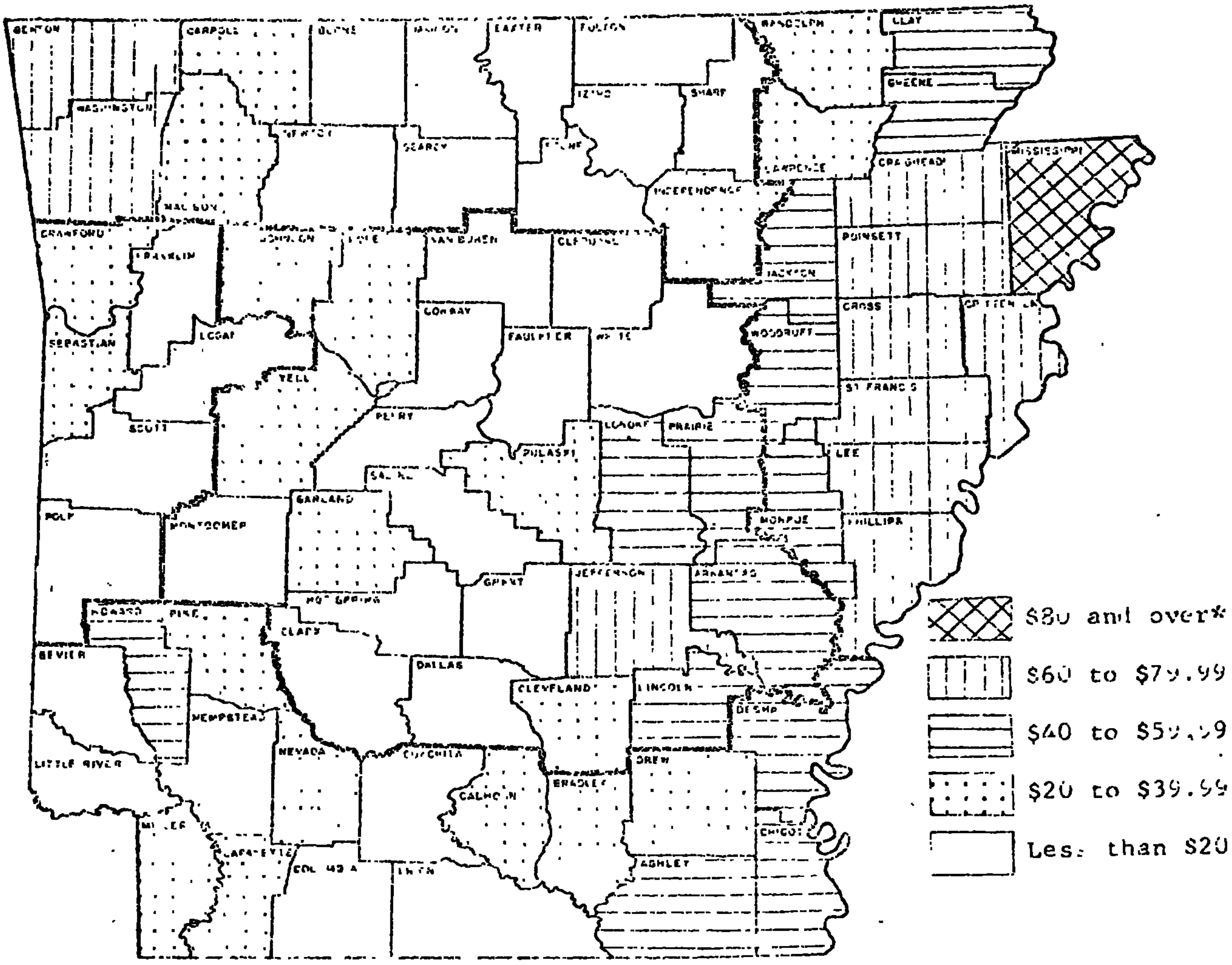
The project's interrelated uses

While navigation on the Arkansas was historically disturbed by episodes of low water and flooding, agriculture and its many related industries in Arkansas has been plagued not only by floods but by excessively high groundwater tables associated with the rivers. Reservoirs constructed on the tributaries of the Arkansas, as well as those on the main stem, have become part of the water "problem" in Arkansas: one of the functions of the ARDP is to conserve water, while a major concern of water management--at least in the eastern Delta region comprising over one third of the state--is to get rid of it, due to the very slight fall of the rivers and the flat, lowland topography. It is not, then, surprising that agricultural interests in Arkansas have expressed anxiety about rising water tables which might result from impoundments (or, conversely, about lowered tables resulting from increased industrial use), and about the fact that appreciable acreages of the best agricultural land in the eastern part of the state--the river bottoms--are being inundated.

The maps provided in Figures 2-5 and 2-6, which follow here, illustrate these points. Figure 2-5 maps the drainage areas and shows how the area of

Figure 2-4

PRODUCTIVITY OF FARM LAND (VALUE OF FARM PRODUCTS SOLD PER ACRE OF LAND IN FARMS), ARKANSAS, 1959



* Mississippi, $105.72

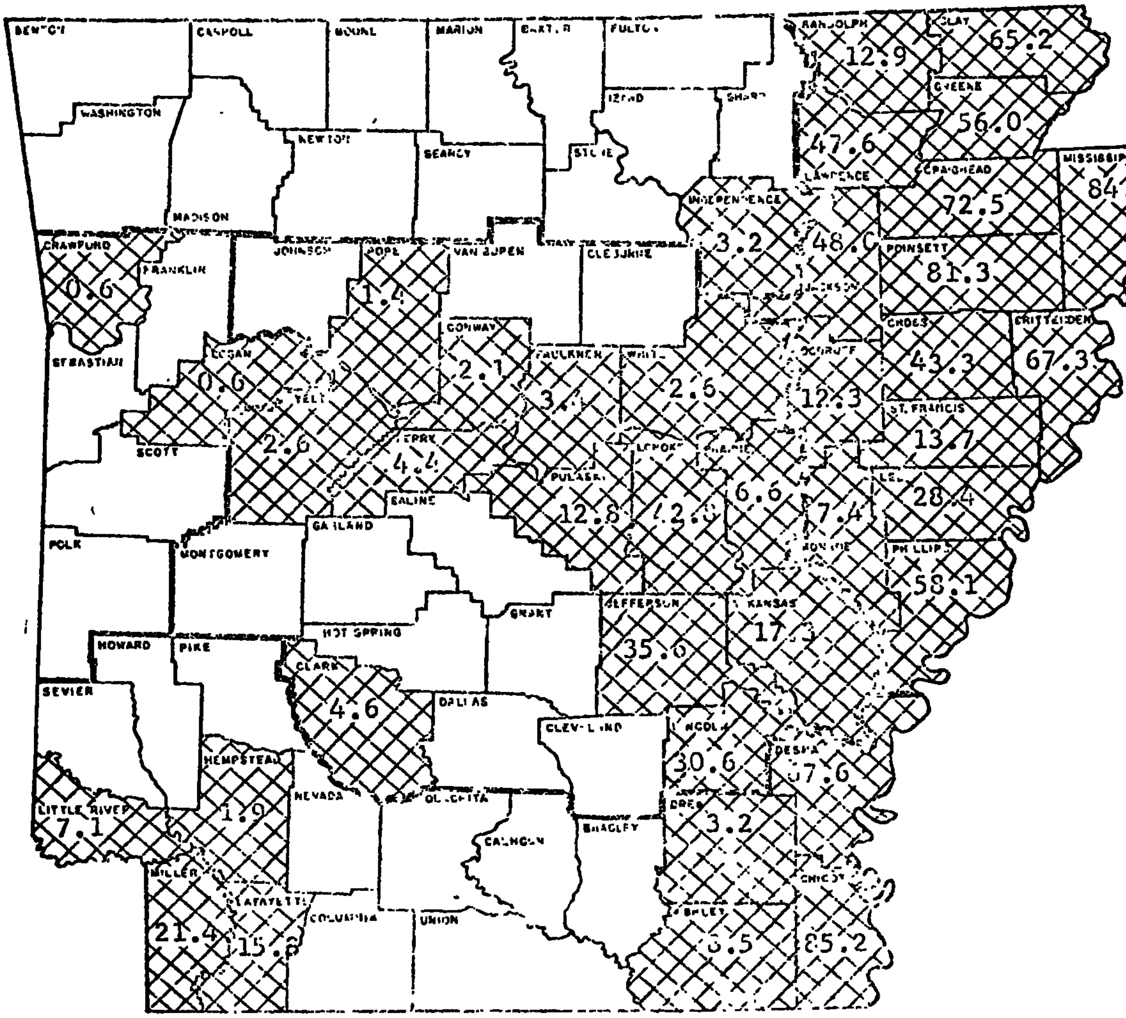
State: $38.84

Source: U. S. Census of Agriculture, 1959, Vol. 1, Part 34, "Arkansas," U. S. Department of Commerce, Bureau of the Census, U. S. Government Printing Office, Washington, D. C.

Source of Map: ARKANSAS RIVER REGION REPORT, Little Rock, Arkansas Planning Commission, 1965.

Figure 2-5

PERCENT OF TOTAL LAND AREA SERVED BY DRAINAGE PROJECTS, ARKANSAS, 1960



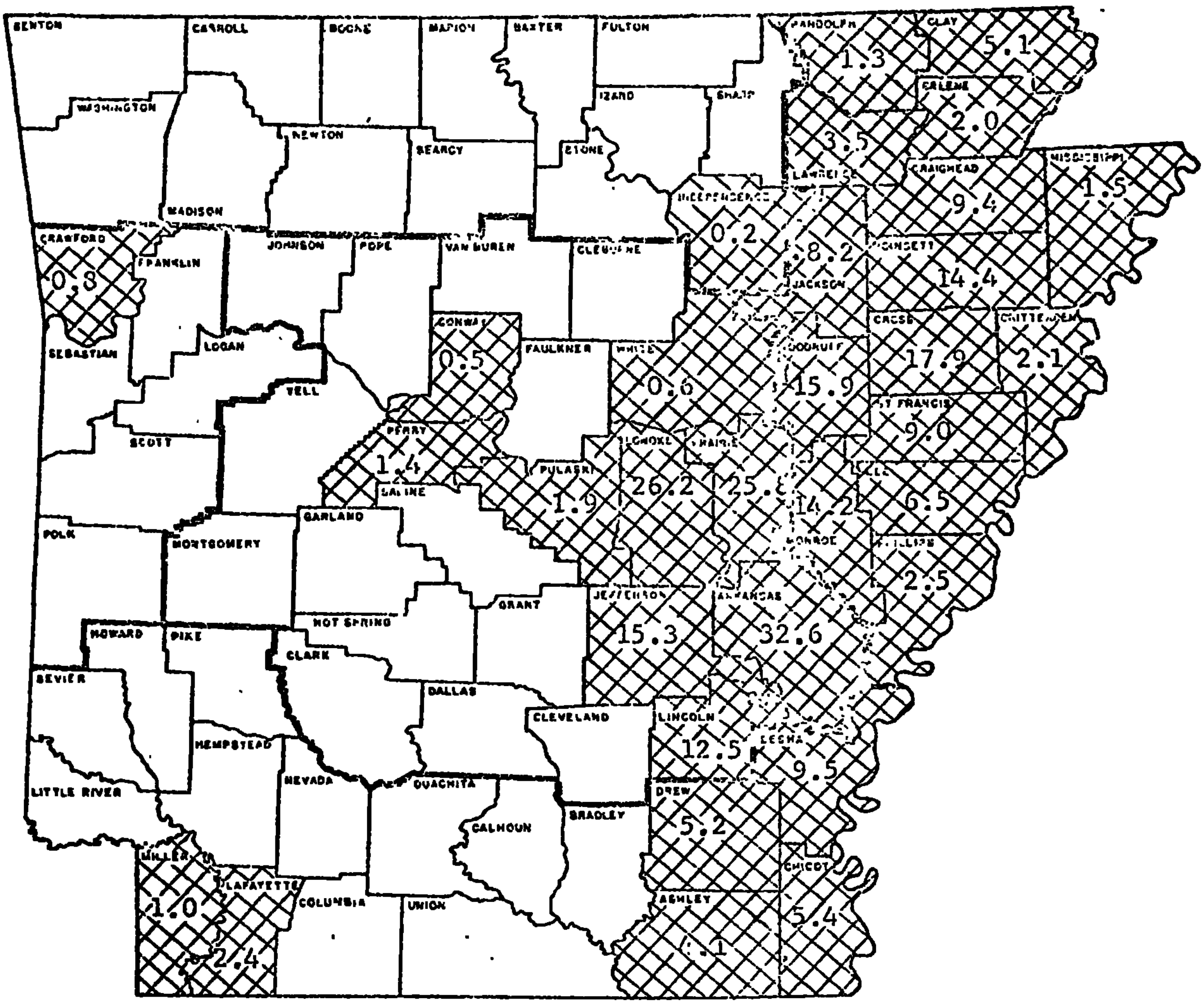
State: 14.5 percent

Source: U. S. Census of Agriculture: 1959, "Drainage of Agricultural Lands", Vol. IV, U. S. Department of Commerce, Bureau of the Census, U. S. Government Printing Office, Washington, D. C.

Source of Map: ARKANSAS RIVER REGION REPORT, Little Rock, Arkansas Planning Commission, 1965.

Figure 2-6

COUNTIES WITH IRRIGATED FARMS AND PERCENT OF TOTAL
FARMLAND IRRIGATED, ARKANSAS, 1960



State: 5.1 percent

Source: U. S. Census of Agriculture, 1959, "Irrigation in Humid Areas," Vol. V, Part 2, U. S. Department of Commerce, Bureau of the Census, U. S. Government Printing Office, Washington, D. C.

Source of Map: ARKANSAS RIVER REGION REPORT, Little Rock, Arkansas Planning Commission, 1965.

excessive water follows the two major river basins, the Arkansas and the Mississippi. The irrigation map, Figure 2-6, shows how irrigated cropland (the best in the state, in most cases) also conforms to this drainage area. The consequences of the ARDP for the relationships between these two factors will be important and bear close scrutiny. Further reference to examining these interrelationships will be found in Part IV. This is doubly important because most of the available descriptions of research on the ARDP features port facilities, dams, lakes, recreation and new industry, to the exclusion of other economic and social factors. Clearly, the program will have far-reaching consequences in many areas which are not of immediate primary importance. The long-run consequences for the environment, and perhaps for the economy, may be considered.

In this context, it is important to review the Arkansas River as an ecosystem, both in its wild state and in light of the changes which the project may effect in this system.

The river as an ecosystem

The Arkansas, a perennial river in an alluvial valley, is closely related to the groundwater reservoir beneath it. Such reservoirs hold several times as much usable water as all the lakes and surface reservoirs combined. A stream receives water from the groundwater table when it is at low stages and recharges the groundwater reservoir at high stages. The Arkansas River, before the project, was highly erratic, its flow depending on seasonal rainfall and runoff. Generally, "the movement of groundwater is from the valley wall to the river, and river acts as a drain throughout most of the year."[1] Now, as a result of project channelization and water storage facilities constructed to minimize flooding and insure a nine-foot depth for navigation all along the river, the groundwater recharge pattern may change. Underground reservoirs near the river itself may receive more water from the river. Wells near the river that draw on the groundwater create an aquifer between the river and the well, further encouraging the river to flow into the underground water reservoirs.

The groundwater table in the Arkansas Valley was recharged primarily by the infiltration of rainfall. The amount of recharge depends on the ability of the soil to absorb moisture. In places the soil strata cannot absorb the water as fast as it is supplied, and marshes and swamps are formed.

An active river in an alluvial valley, like the Arkansas River in its natural state, constantly meanders by eroding its banks and depositing the material elsewhere. Erosion takes place on the outside of each bend, where the turbulence is greatest. The detached material is carried downstream and dropped where the water moves more slowly, either at the inside of the next bend or in the center of the channel. Sometimes, when bends are sharp, the river shortens its course by making a cutoff across an intervening neck of land. An oxbow lake is formed, and, if sedimentation continues, it develops into a swamp. In this way, the river channel is always moving. Each lateral movement leaves a nearly level deposit, which becomes the floodplain. The river floodplain is further built up during flood stage when water spreads out over the valley floor and deposits sediments.

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[1]Bedinger, M. S., L. F. Emmet and H. G. Jeffery, 1963. "Ground Water Potential of the Alluvium of the Arkansas River Between Little Rock and Fort Smith, Arkansas." U.S. Geological Survey Water Supply Paper, 1669-L: 1-29.

The river floodplain provides a variety of habitats; the stream itself, the streambank, swamps, lakes, sandbars, high, dry areas of abandoned river bed, etc. Complex species associations characterize each different area. As the sites are modified by the actions of the river or by aging and maturing processes, the species associations change.

Clearly, the ARDP will drastically modify all of these natural processes which, while entirely appropriate to a river of this type, have proved extremely inconvenient to human uses of the river and its floodplain. What effect the river as a controlled instrument of human manipulation will have on the ecology of its immediate region it is not possible to foresee in detail. But we must consider the elements of this ecology.

Depicting the ecology of any region requires, of course, the consideration of such interrelated factors as land forms, soil types, climate, and the distribution of mineral resources, as well as the natural vegetation and the animal life within the area. In the Arkansas River Basin, moreover, we encounter marked variations which alter the intricate relations of all these factors.

For example, rainfall is usually heaviest in the spring and summer months throughout the Basin area, but the amount of precipitation ranges from over 50 inches in the humid eastern portion to about 25 inches in the semi-arid western portion. What is ecologically more significant, precipitation in the western portion is capricious, and the area often swings pendulum-like between short periods of sudden heavy rains, which can deliver the total amount of yearly rainfall within a short span of time, to periods of extreme drouth which periodically extend over several seasons.

The terrain of the area is as varied as the rainfall. The 60,000 square mile project area has elevations ranging from 2900 feet above sea level in the Ouachita mountains near the Arkansas-Oklahoma border, to 150 feet at the mouth of the Arkansas and White Rivers.

The Arkansas River flows through portions of the southern part of the Great Plains, through the mixed sand and clay of Oklahoma prairie soil. "Grass and sky" describes the prairie landscape here as aptly as the Argentine pampas. The tall- and mixed-grass prairie is unrelieved except for the thickets of cottonwood, sycamore and willows growing along stream banks.

The river continues through the interior highlands of the Ouachita and Ozark mountain provinces where, according to E. Lucy Braun, the "oak-hickory forest reaches its best development and greatest diversity in composition. Here the largest number of species of oaks and hickories occur."[1]

Large areas of both the Ozark and Ouachita highlands have soils unsuitable for agriculture, but as the river proceeds downstream, through these interior highlands and into the gulf coastal region, the area becomes abundant in productive diversity. This rich lowland of alluvial deposits and fertile flood plain contains a unique and biologically varied environment of natural swamp and significant areas of vanishing bottomland hardwoods.

The river, then, is a large and complex system containing many sub-environments. It has sometimes been an advantage to the region; at other times it has posed a real problem. True, it feeds the region's groundwater system and has been used for navigation for over a century. However, it has also

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[1]Braun, E. L. Deciduous Forests of Eastern North America. Hafner, New York and London. 1964.

caused flooding and erosion, while an adequate stream flow could never be depended upon.

The river as a challenge

The extreme unreliability of the river as an instrument for human use has inevitably made of its control a challenging object of human ingenuity and effort, with a long and complicated history, dating back to within a few years of the Louisiana Purchase which brought the river and its basin within the Federal polity. Except for quite local and ephemeral measures such as levee construction and the removal of temporary navigational hazards, any effort at control of the river has from the start necessarily posed so formidable a problem as to require Federal action, with the result that this history is from the outset a compound of engineering and political considerations. It is, until the past 15 years, almost solely a legislative history, mirroring the changing concepts of river development in the national consciousness over a span of almost 150 years.

The record is detailed in Appendix A, and it makes a fascinating study of the very gradual reconciliation of disparate objectives and judgments within a multi-dimensional framework embracing fiscal policies, alternative engineering solutions, political rivalries and often competing concepts of the public good. Contributions of individuals involved in the process are noted in Appendix B, while a chronology of appropriations in furtherance of the project is presented in Appendix C.

Two aspects of this record are of particular relevance to the present study and merit highlighting here. The first is that control of the river has continuously held a prominent place in the aspirations of the people of

Oklahoma and Arkansas and in their representations to the Congress. In the light of later developments, it is interesting that the Arkansas first appears in the record as a navigation project, with an authorization for channel improvements between the mouth and Fort Smith in the Rivers and Harbors Act of 1832. Thereafter, for more than a century, navigational improvement of the river was a constant focus of representation to the Congress, but of a rather localized nature. That is, it was a cause of critical interest only to constituencies directly affected--first along the lower reaches in Arkansas, later into Oklahoma. It is only in very recent decades that the regional impact of a navigation channel to Tulsa has been thoroughly recognized, even within the affected states. In this regard, it is interesting to note that when authorization for the multi-purpose project (central feature of which was the navigation channel and its attendant works) was finally voted in 1946, Sen. Monroney of Oklahoma offered an amendment to delete funds for the Arkansas project. Congressmen Stigler of Oklahoma and Cravens and Harris of Arkansas successfully countered Monroney's action, claiming that he opposed the project simply because it would not directly benefit his immediate constituency (Oklahoma City). By 1964, Sen. Monroney was able to press for an increase in the President's budget allocation to the project by saying: "The only solution to low median family income, high rates of unemployment, high welfare costs, deteriorating farm income, low Federal and State tax income, and problems of health, education and poverty is the completion of the project, as scheduled, by 1970." The considerable enlargement in the Senator's grasp of social economics in the 18-year interval, it must be noted, is one he shared not simply with his constituency but with the nation at large.[1]

But the aspect of river control which most signally engaged the aspirations of the two states' citizens throughout the years and elicited the most urgent appeals to Congress was flood control. Ironically, the most disastrous floods, which understandably occasioned the most energetic pressure on the Congress--productive, at least, of authorizations for comprehensive study of the river system--were always followed by periods of national crisis which effectively stymied any carrying forward of projected works. Thus, the great floods of 1912, 1927, and 1936-37 initiated actions which were frustrated respectively by World War I, the 1929 crash, and World War II. The 1927 floods did, however, lead to passage of the Flood Control Act of 1928, which first incorporated into public law the concept of comprehensive river-system control and, as such, may be said to have opened the way for basin development throughout the country. In 1938, after a decade of concerted support from the Oklahoma and Arkansas delegations, the articulated flood control plan for the Arkansas was authorized. Pressure for appropriations to achieve the works continued on an equally unanimous basis in the following years, whereas the additional multi-purpose features were championed, at first, primarily by Arkansas Congressmen--in particular, Sen. McClellan and Rep. Mills. By the time of its authorization in 1946, as we have seen, the multi-purpose plan had its Oklahoma champions too, as well as its detractors. Once it was approved, however, the appeal to Congress and the Budget for construction funds came to enlist all members

[1]It will be noted that of 41 citations in that part of the attached bibliography dealing with the economic implications of basin development, only one antedates 1950, while only eight antedate 1960.

of the two delegations. We have already noted that the name most popularly associated with the full project is that of Sen Robert Kerr of Oklahoma.

Nonetheless--and this is the second instructive point we may observe from the record--there exists a dichotomy between flood control and navigation so fundamental that it has had thoroughgoing effect, both in the engineering and legislative history of the project and in its presentday fiscal structure. Even after the 1960 enactment of Public Law 645, 86th Congress, 2nd session, whose specific purpose was to integrate administration of the flood control and navigation features of the Arkansas Development Project, cost accounting of the navigation plan has been kept separate from that of the flood control features (except for Eufaula, Keystone and Oologah reservoirs, which are charged to the navigation plan). This cannot be taken as the result of historical accident--particularly not in view of the very early attention given to navigational improvement of the river. Rather, it mirrors a real incompatability of purpose, whose effect we have already noted (The Project's Interrelated Uses). The navigation plan is designed to meet the aspirations of industrial sectors whose importance to the basin's economy have grown in recent decades and seem now to hold most promise for its future; whereas the flood control plan, although it also offers security for industrial uses, was primarily conceived to reduce heavy and recurrent losses in the agricultural sector. The priority given the flood control plan reflects the erstwhile primacy of agricultural production in the basin economy, whereas agriculture will not utilize the navigation features and fears harm from them as a result of flooded lowlands and raised groundwater levels.

The integrated ARDP, then, must be seen as a worthy effort to please everyone, to meet what may prove to be, to some extent, competing aspirations. Its impact on the lives and attitudes of the people it is designed to serve may have to be measured in satisfaction not unmixed with frustration. This is the unmistakable import of a sampling of opinion made throughout the basin in 1970 and presented in Appendix D.

PART III

THE REGION AND ITS PEOPLE

There are, of course, many ways to define "region," and in the discussion to follow it will be necessary--depending on the problem and the context--that our definition of the "Arkansas River Region" will change somewhat, from situation to situation. But the definition which we feel is most useful as the standard designation of the ARDP impact region is an area of 42 counties, 17 in Oklahoma and 25 in Arkansas. The counties comprising this two-state region are shown here together in Fig. 3-1.

Beyond this standard impact region, we will want to look at other areal aggregates in some situations; in particular, for a number of problems we will want to look at smaller areas. Most commonly, we will want to look at the Oklahoma and Arkansas sectors separately, not simply for statistical convenience but also functionally, since they are distinct both jurisdictionally and culturally. As a matter of sheer convenience, the Oklahoma region most frequently considered will be the 7-county "official" area, since it has been closely studied.[1] When identifying economic and demographic characteristics, we will frequently consider the Oklahoma group of counties, and the four Arkansas subregional groups, minus their urban-center counties, which so weight the aggregate figures as to cause considerable distortion. Beyond this, we will sometimes want to look at special county groupings when considering particular impacts--for example, the Tulsa and Little Rock areas as SMSAs, the hill counties, the lower Arkansas, Muskogee and the lesser urban areas of the Arkansas subregions. Finally, on a sample basis, we will want to look at individual counties or communities.

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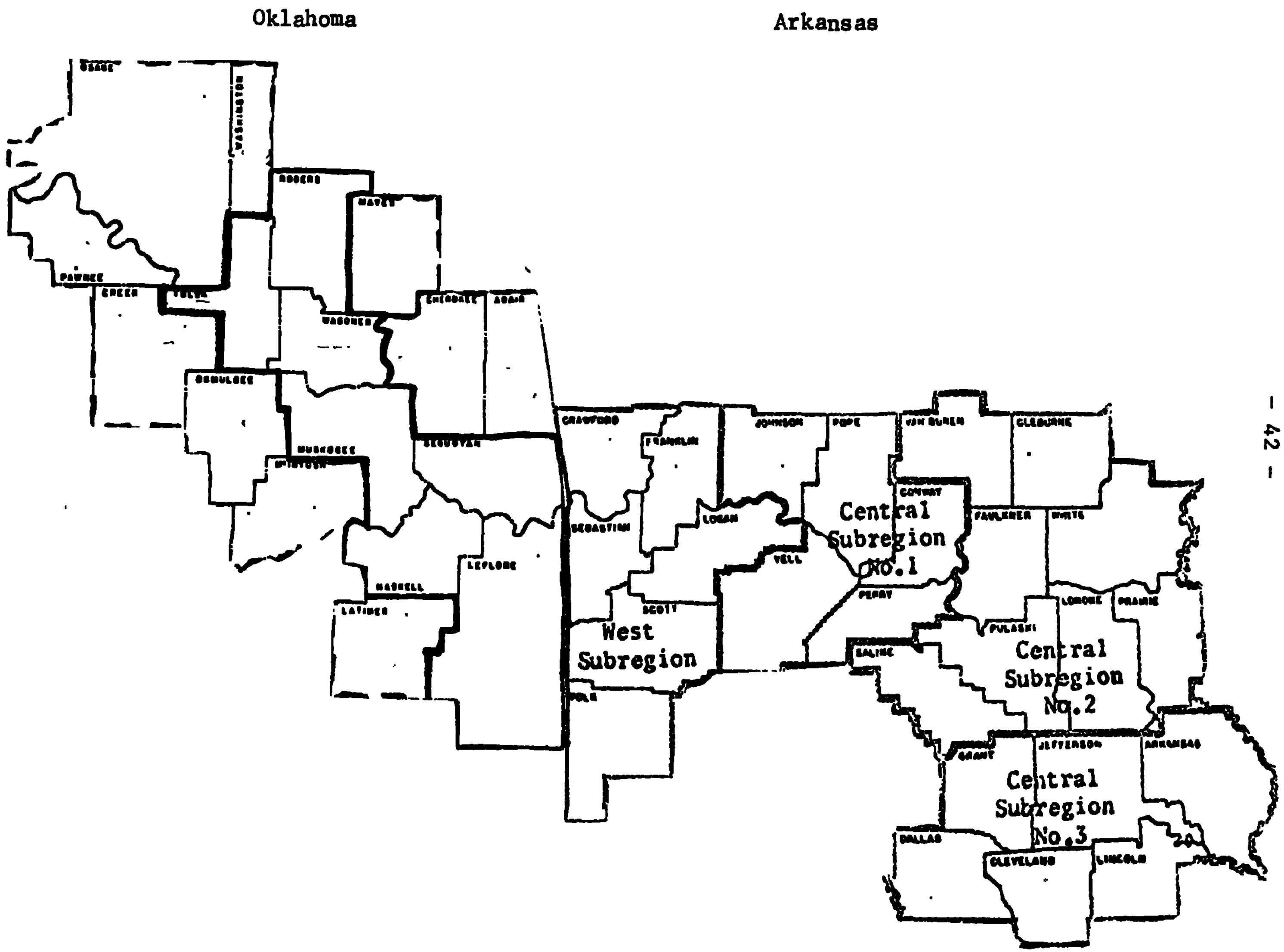
[1]Most particularly in The Arkansas River Basin in Oklahoma, An Economic Base Study, Dr. Jack L. Robinson. University of Oklahoma Research Institute, Norman, Okla. September, 1967.

Figure 3-1

ARDP Region



The economic and cultural geography of the impact region is best summarized in terms of the two state areas.

The part of Oklahoma immediately affected by the river is the northeast and includes Tulsa, the largest city in both states. Downriver from Tulsa is the secondary service center of Muskogee. Directly north of Tulsa is suburban Washington County, anomalous for its high income and educational levels and for its degree of urban concentration in unincorporated areas. In the 1960 census, Creek and Osage counties, but not Washington, were included in the Tulsa SMSA. Proceeding southeast along the river from Tulsa, the population (excepting Okmulgee) becomes increasingly rural as one enters the Ozark region, including the "Indian" counties (Haskell, LeFlore, Cherokee and Sequoyah). The triangular group of counties northeast of Tulsa, and perhaps including the Eufaula area near Okmulgee, to the immediate west of the mainstream, constitute, as noted earlier, the "Green Country"--a hilly, forested extension of the Ozarks.

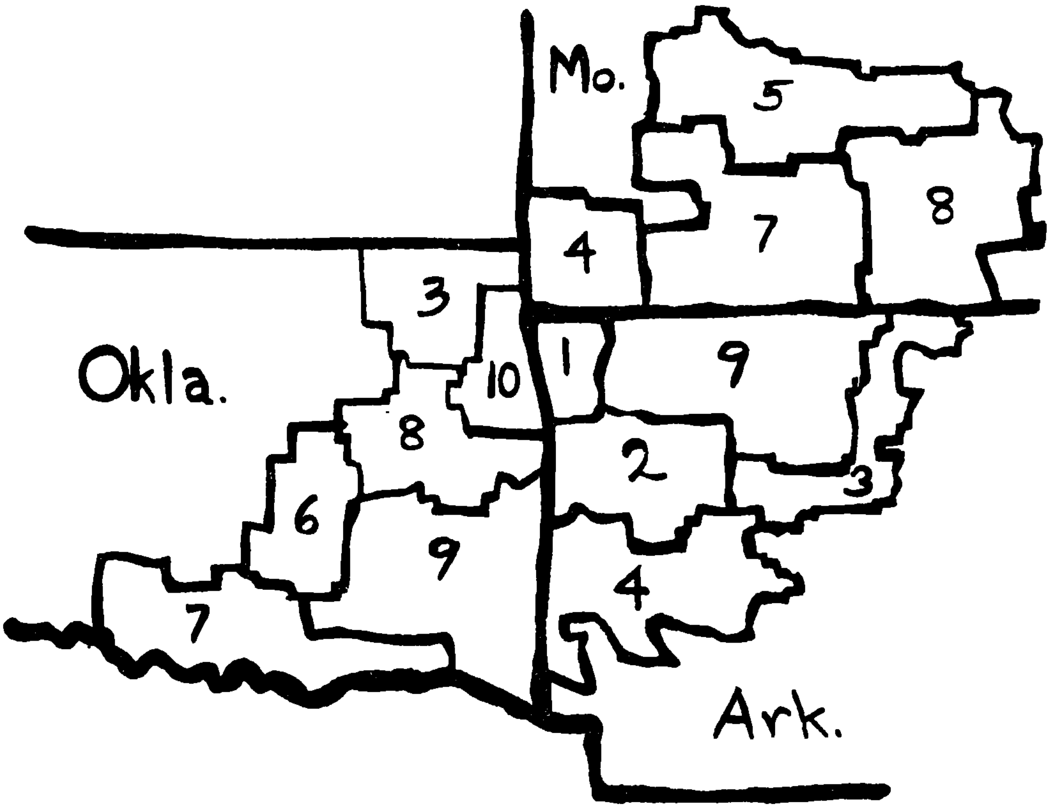
In Arkansas, the river traverses the entire state, necessitating a finer breakdown of subregions, as noted above. These regions along the river vary: The West Subregion comprises six largely agricultural counties, but includes a smaller city with "retarded" growth, to quote one of the reports. This is Fort Smith (Sebastian Co.), designated an SMSA in the 1960 census and comprising Sebastian and Crawford counties in Arkansas, LeFlore and Sequoyah counties in Oklahoma. Next downriver, Central No. 1, is a largely agricultural subregion containing the riverport city of Russellville (Pope Co.) and comprising 5 counties. Between Central No. 1 and the Delta where the river enters the Mississippi lie Central No. 2 and Central No. 3, including the Little Rock-Pine Bluff strip, mixing urban concentration with agricultural activity, similar to the Tulsa-Muskogee strip of the river in Oklahoma. Central No. 2 comprises 8 counties. Only Pulaski County is included in the Little Rock (and North Little Rock) SMSA, but Saline County, with its aluminum industrial development, bears much the same relationship to Little Rock as Washington County to Tulsa. Central No. 3, 6 counties in extent, includes Pine Bluff, designated an SMSA in a special census of 1965 with Jefferson as its only constituent county. The area south and east of the Little Rock-Pine Bluff stretch of the river is heavily agricultural and relatively prosperous.

The two-state designation of the Fort Smith Metropolitan Area underscores the special problem of this border city. It is 164 miles from Little Rock, but 115 miles from Tulsa, a larger city, and only 65 miles from Muskogee, in the Tulsa development area. Yet it is in Arkansas, and therefore not included in development plans for the state which constitutes its closest industrial and urban hinterland. Clearly, Fort Smith's economic health is dependent on bi-state vision and developmental planning, although it is undertaking a modest port development on its own.

Figure 3-2 is a sketch map of what one team of analysts has considered to be the "Ozark low-income" area in Missouri, Oklahoma, and Arkansas. Divisions indicated are not counties, but "state economic areas" as defined by development officials (for definitions, see the source publication cited on the Figure). The territory mapped may well define the <u>lowest</u>-income areas in the three-state region, but for Arkansas the area is too small. Counties with various degrees of poverty problems extend across the entire north, or Ozark, half of the state, while there are substantial rural poverty districts in the central and south-central portions as well. Approximately half the counties of Arkansas

Figure 3-2

OZARK LOW-INCOME AREA[a]



[a]108 counties consisting of census State Economic Areas 1, 2, 3, 4, and 9 in Arkansas; 4, 5, 7, and 8 in Missouri; and 3, 6, 7, 8, 9, and 10 in Oklahoma.

Source: R. L. Sandemeyer & L. B. Warner, Determinants of Labor Force Participation Rates with Special Reference to the Ozark Low Income Area. Research Foundation, Oklahoma State University, 1968.

qualify as low-income, or low-labor-participation areas. It is noteworthy that the Arkansas River flows through only a small portion of the low-income areas in the two states, although all of the counties involved have been a source of rural migrants to the region's cities.

Levels of economic activity

Throughout the following overview of the impact region, we will be observing groups of counties in the two states which, apart from their great disparity in size, are roughly analogous. That is, each is an aggregate of largely rural counties with a metropolitan center, while each cluster of counties contains as well a smaller city. In Arkansas, the metropolitan Pulaski County is midway in the river region, while the West Subregion has Fort Smith (Sebastian Co.), Central No. 1 has Russellville (Pope Co.) and Central No. 3 has Pine Bluff (Jefferson Co.), now designated an SMSA. In Oklahoma, Tulsa, Osage and Creek counties comprise the metropolitan area, while Muskogee, downriver, is the smaller city. Figures for these urban centers inevitably distort statistical reporting for both the total impact regions and the subregions, and it will frequently be necessary to consider the county aggregates minus their urban counties in order to get a true picture. This is particularly so, of course, for the small, 7-county Oklahoma region which we must use for statistical purposes: in almost every case we will have to look at the 6-county region separately--that is, without Tulsa.

In fact, it will be seen that all of the indices of economic vitality examined here are more acutely contrasted in Oklahoma, and by no means simply because of the compactness of the Oklahoma region. The Oklahoma counties have experienced the processes of recent change more rapidly and on relatively greater scale than in Arkansas. One might, in short, describe the characteristics and contrasts of economic life in the Arkansas region and then simply say of the Oklahoma counties that "they are the same, only more so."

All tables referred to in this section will be found at the end of Part III.

Unemployment

In all the impact counties of Oklahoma and in most of those in Arkansas, unemployment levels have been high for a number of years (see Tables 1 and 2). In 1963, when we have comparable figures for the two states (minus 3 of the Arkansas counties), the U.S. average unemployment was 5.7%, while the average in both states was 5.1. All six of the non-urban counties in Oklahoma averaged over 10% (ranging to a high of 20.9 in Haskell), while the average in the Tulsa SMSA was 5.3. In Arkansas, 8 of the 22 counties for which we have figures were 5.1% or lower (with Pulaski, of course, the lowest at 3.0), while five of the remaining 14 were above 10% (ranging to a high of 15.1 in Crawford).

The import of these figures for the present study is twofold. First, they indicate that a considerable pool of surplus labor exists for whatever employment opportunities result from the ARDP;[1] second, while unemployment has been acute in the Oklahoma counties and in many of the Arkansas counties, the figures suggest that a truer picture of the area's economic deprivation must be sought in income levels, unemployment and under-participation in the labor force.

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[1]See, Arkansas Labor Surplus Estimates. Industrial Research and Extension Center, College of Business Administration, University of Arkansas, Little Rock. 1968.

Employment

We are observing here an agricultural region in transition to industrialization, and a breakdown of 1960 employment by industry (Tables 3 and 4) is very instructive. By 1960, the most staggering losses in the region's agricultural employment had already taken place (Tables 4 through 11), but in both states the agricultural percentage of total employment was still well above the U.S. figure of 6.7. In the Oklahoma 6-county region it is 11.8, while in the 25-county Arkansas region it is 10.6. Also, it will be seen that in Oklahoma, even including Tulsa (and for Tulsa separately), trade shows the highest employment, followed by services and manufacturing; whereas nationally, manufacturing is first, followed by services and trade. Table 4 shows that in 1960 this national pattern prevailed in the Arkansas region; but in 1950, when in Arkansas agriculture was still the category of highest employment, trade was second, with manufacturing a poor third, followed closely by services. It will be noted that mining in the Oklahoma counties has about four times the importance it has nationally, whereas in the Arkansas region it has less than national importance.

But the most impressive and significant observation to be made from Tables 4 through 11 is the concurrent decline in agricultural employment and increase in manufacturing employment between 1940 and 1960. In three of the Oklahoma counties the 1960 figure for agricultural employment is one-fifth or less of the 1940 figure; in three others barely one quarter; and in Tulsa itself only a bit over one third. In the same group of counties, the least increase in manufacturing employment during the same period is 25% (LeFlore) to almost 250% (Sequoyah). In the Arkansas region, over the same 20 years, agricultural employment is seen to decline by 70.4%, while employment in manufacturing increases by 114.9%. Thus, the same transition is in progress in the two states' river regions, but on a more drastic scale in Oklahoma. This is underscored by the fact that in the six-county Oklahoma region total employment declined between 1940 and 1960, which enhances the importance of the growth in manufacturing opportunities for employment. As an extreme case, in Sequoyah County total employment declined by almost 15% in the period, while "operatives" increased by 300% and "craftsmen and foremen" increased by 135% (Table 12).

These shifts in employment are instructive in terms of the changing economic base within the regions, but they do not tell us much about income levels. For this, it is more fruitful to look at occupational breakdowns of employment in the regions (Tables 13 through 18), since we learn from Table 19 that the lowest-paying male occupations in the nation are agricultural workers (farmers, farm managers and farm laborers), laborers, service workers and operatives; while the highest paying are professionals and managers. In all except the urbanized counties, we note in the river regions of both states high employment in all the low-paying categories and conversely relatively low figures for the high-paying categories.

The weighting effect of the urban counties is particularly distorting in these occupational data. In the aggregate figures for the two river regions (Tables 13 and 14), note that both "look better" than the national figures in all the categories of particularly high and particularly low pay, except for the percentage of male farm laborers in the Arkansas region. And in Arkansas, since <u>all</u> of the state's industrial urban centers lie along the river (Fort Smith, Russellville, Little Rock, North Little Rock and Pine Bluff), the river region consistently "looks better" than the rest of the state.

The distorting effect of Tulsa is obvious from a glance at the 6-county and 7-county totals (Table 13), but a study of Table 18 shows how an industrial center as small as Pine Bluff (Jefferson Co.) can weight subregion totals. The striking anomalies to the U.S. norm appear only in a close examination of the individual counties.

The above-average percentiles of workers in the lowest-paying occupations in the non-urban counties, and the below-average percentiles in occupations at the top of the income scale do much to explain the low incomes in the two regions. Also instructive, in terms of family income, is the degree of participation in the labor force, since the lower the rate of participation the fewer family members are contributing to the average family's support. Table 20 shows that, with the single exception of Tulsa, all the statistical units used in this overview of the two state regions had lower participation rates than the national average in 1960. In the six Oklahoma counties, the percentage points of difference from the U.S. figure range from -7.0 (Rogers Co.) to -22.1 (Sequoyah Co.) for males, and from -3.7 (Muskogee Co.) to -17.2 (Haskell Co.) for females. The Haskell Co. figure is exactly half the national participation rate for females. In the Arkansas subregions, the range is from -5.7 (Central No. 2, Little Rock) to -13.1 (Central No. 1) for males, and from -0.5 (Central No. 2) to -8.3 (Central No. 1) for females. It is generally conceded that low labor force participation rates reflect a complex of factors: they represent the number of persons who have either given up or, for one reason or another, have never desired employment or considered themselves employable. As such, they are primarily associated with generally low educational levels and with a simple lack of employment opportunities.

Income

Throughout the impact region in both states, income is observably low--when the urbanized counties are excepted, very much lower than the U.S. average and below that for the rest of the respective states. In 1960, when the U.S. median family income was $5660, it was less than half that figure in three of the seven Oklahoma counties and in seven of the proposed 17.[1] Of the 17 Oklahoma impact counties, only Tulsa and its suburban Washington Co. attained the U.S. level (both exceeded it), or even the Oklahoma state median family income of $4620, (See Table 21 and Fig. 3-3).

In Arkansas, not one of the 25 river counties attained the U.S. median income figure in 1960, and in 14 of them median income was less than half the U.S. figure. These results are remarkable since they indicate the prevalence of very low incomes even in highly urbanized Arkansas counties. Table 22 is included here since it demonstrates the weighting effect of these counties in the Arkansas subregions. We have had much occasion to point out the extreme contrast in economic levels between Tulsa and the other counties of the Oklahoma region (a contrast even more striking between Washington and the other counties in the proposed enlargement of the region), but in Table 22 we are able to see,

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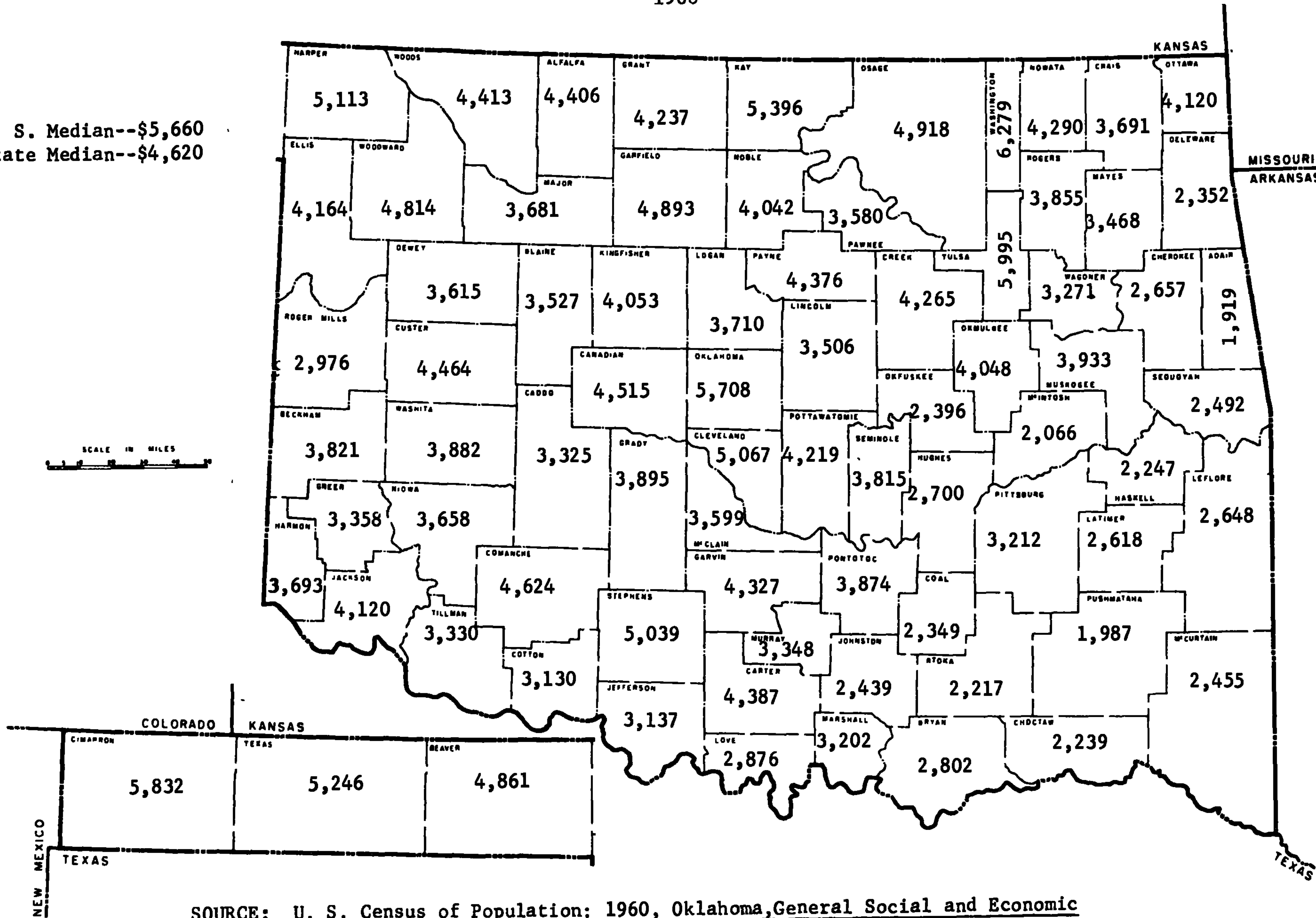
[1]Since the figures were readily available, we have expanded Tables 12 and 23 to include the 10 additional counties of Oklahoma proposed for the impact region. The effects on aggregate figures observable in Table 23 from adding the ten counties can be expected to prove typical for all socio-economic measurements, and so are worth noting. It will be observed in Chart 1 that, among the added ten, Washington Co. has the highest median family income of any county in the state; Adair has the lowest; and McIntosh has the third lowest. That is, we have added one suburban county which has even higher income levels than Tulsa (already a distorting factor in aggregate figures), while we have also added two rural counties with income levels even lower than Sequoyah and Haskell (the 'crisis counties' of the seven-county group). Cherokee and Latimer are similar to the originally studied six-county group, while the remaining five additions (Creek, Hayes, Okmulgee, Osage, and Pawnee) have higher income levels. The implications are that the 17-county group, in the aggregate, would somewhat more closely approximate characteristics of the 25-county Arkansas group, while it would frequently be necessary to excerpt Washington Co., as well as Tulsa, in order to obtain an accurate sense of conditions on the exurban counties which comprise the preponderant extent of the impact region.

Figure 3-3

Median Family Incomes
1960

U. S. Median--$5,660
State Median--$4,620



SOURCE: U. S. Census of Population: 1960, Oklahoma, General Social and Economic Characteristics, Table 86.

on a less drastic scale, the same effect in each of the Arkansas subregions. Each of the four subregions contains one of the four major urban concentrations in the state of Arkansas: Fort Smith (Sebastian Co.) in the West; Russellville (Pope Co.) in Central No. 1; Little Rock and North Little Rock (Pulaski Co.) in Central No. 2; and Pine Bluff (Jefferson Co.) in Central No. 3. In the 1960 figures for per capita income in the Arkansas subregions, we observe that per capita income is 70% higher in Sebastian and Pulaski counties than in the remaining parts of their subregions, while in Pope and Jefferson counties they are 17% and 20% higher than the remainder of the subregions. (Saline County, it may be noted in Table 21, bears a similar relationship to the Little Rock metropolitan area as Washington County does to Tulsa.) Thus (with Saline Co.) there are five relatively high-income counties in the Arkansas region, compared with only two in the expanded Oklahoma region. Yet, even with this wider weighting, the median income figures seen in Table 22 show generally lower levels in Arkansas then in Oklahoma. This clearly indicates a continuing greater prevalence of very low incomes even in the urbanized areas of Arkansas--a conclusion supported by Table 23.

In 1960, the minimum family income, below which a family was considered to be living in poverty, was designated as $3000, and 21.4% of U.S. families were found to have incomes in this category. Table 23 shows the extent of this poverty level in the River Region counties. Looking first at the urban-center counties, we note, in Oklahoma, that only 15.1% of the families in Washington County and only 17.2% of those in Tulsa County had incomes below $3000 in 1960--both well below the U.S. average--while all of the Arkansas urban-center counties had a higher percentage of families in the "poverty" category than the U.S.:

Sebastian (West)	32.6%
Pope (Central No. 1)	49.2%
Pulaski (Central No. 2)	25.9%
(Saline)	31.8%
Jefferson (Central No.3)	42.8%
(U.S.	21.4%)

Looking, then, at the still largely rural counties, we find extremely high components of poverty-level families. In the 17-county Oklahoma region, all but one of the rural counties had from over one third to over two thirds of all its families within the poverty level (the exception is Osage County, part of the Tulsa SMSA, which had only 27.6% of its families so situated). In the rural counties of Arkansas, the least component of poverty-level families was 45.1% (Arkansas Co.), while in 17 of the 20 it was over 50% of all families.

In view of these figures, it is not surprising to find, in Tables 24 and 25, that transfer payments---consisting largely of welfare assistance--comprise a much larger portion of personal income throughout the river regions in both states than in the U.S. average. Table 24, for Oklahoma, is based on 1962 data and Table 25, for Arkansas, on 1963; but in both years the transfer-payment component of total U.S. income was 7.9%. In the six Oklahoma counties it ranges from 14.1% in 1962 to 31.8%, and in the Arkansas subregions in 1963 from 8.22% to 15.7%. Again it is necessary to point out that the aggregate subregional figures for Arkansas are considerably weighted by inclusion, in each, of the urban counties: this effect is strikingly apparent in the Oklahoma aggregate figures, where the rural 6-county aggregate shows a high 19.5% of personal income derived from transfer payments, while the 7-county figure (including Tulsa) is 7.8%--actually below the U.S. average. Table 24 is further interesting for the low wages-and-salaries component of income in the Oklahoma counties which it shows: none of them, including Tulsa, reaches the U.S. figure of 69.8%, while in three of them it is less than 40%. Finally, it has been noted that the relatively high percentages of proprietor income observable in the Oklahoma figures reflects the large number of farmer-owners in the rural counties.

In sum, then, the river regions of impact in both Oklahoma and Arkansas, apart from their urban and rural counties, are areas of relatively quite low income, however it is measured, and of high levels of welfare assistance. Although these factors combine to create acute localized conditions throughout Arkansas and Oklahoma, it is the latter region which shows the sharpest contrasts of economic health and deprivation.

Human resources

In response to the shifting economic base which we have sketched above, the population of the Arkansas River Region is itself in a state of transition and must be characterized as a highly fluid resource. Throughout most of the area, it is becoming smaller, and the considerable out-migration which is causing this loss is largely composed of persons in the "prime working age" group, from 20 to 50, with the result that the remnant population is increasing its components of persons younger and older than this. In addition to the movement out of the river counties, there is also much movement within them, the remnant population shifting from rural to urbanized areas at a rapid rate. We have no figures to indicate movement within the region, between counties, but there is evidence that this, too, is taking place. Of the 32 river region counties which have been studied, three--Tulsa, Pulaski and Saline--experienced net in-migration between 1950 and 1960.

This section will briefly detail these elements of change, but it is important first to note that perhaps the most significant of them--the absolute loss of population--is not obtained for the region as a whole, nor for a number of its subregions or individual counties. Table 26 shows that four urban counties in the Arkansas region had population gains between 1950 and 1960 ranging from 3.9% (Sebastian/Fort Smith) to 23.5% (Pulaski/Little Rock), and these four accounted for enough of the total regional population to offset population losses in the other 21 counties ranging from 1.3% (Arkansas to 27.4% (Scott). As a result, the Arkansas region in the aggregate grew by 1.4% between 1950 and 1960. Again, in Oklahoma the divergence is greater. Tulsa's population increased by 37.5% in the decade and that of Rogers by 5.5%, while the other five counties had losses ranging from 5.7% (Muskogee) to 31.5% (Haskell). The Oklahoma 7-county region, as a result, shows a population gain of 18.6%. It is noteworthy, in Table 25, that the state of Arkansas experienced a 6.5% population loss during the period, while Oklahoma grew by just 4.3%--facts which enhance the importance of the aggregate growth in the two river regions.

The net migration rates of Table 26--expressed as a percentage of the 1960 survivors of the 1950 population and of births during the decade--indicate, however, a widespread defection on the part of the native population. As noted above, only Tulsa, Pulaski and Saline of the 32 regional counties in the two states show net in-migration for the period; of the 29 remaining, 19 have out-migration rates of 20% or more--ranging to a high of 37.2% for Haskell County.

Inevitably, out-migrants are for the most part young and middle-aged adults and preponderantly male, since persons in these categories have the highest degree of mobility as well as the most urgent motivation to better their situation. Table 27 details these characteristics among the out-migrants from the six Oklahoma counties during 1950-60. It is striking that in every county the highest rate of out-migration is for males in the youngest age group--20 to 24--and the second highest for males 25 to 29. Moreover, compared with the out-migration rates for the state of Oklahoma, these rates for the various counties are seen to be twice, three times and even four times those for the state. In the most extreme case, note that Haskell County lost 78.6% of its males aged 20-24, 76.6% of those 25-29, and 57.4% of those 30-34. Except for Rogers County, where there was an influx of persons in the 30-44 age group, the out-migration rates in all the counties consistently decline as they progress into the higher age groups.

This same Table 27 gives some basis for predicating a considerable intraregional migration, although of course the figures available here are not conclusive evidence. Again, note that while Haskell County lost 77.6% of its young people aged 20-24, Tulsa County gained 25.2% more in this age group: since the population of Tulsa County is 36 times that of Haskell (and similarly vaster than that of the other 5 counties involved), clearly it is numerically possible for the Tulsa in-migration to have absorbed all of the out-migration of the other counties. Such a neat exchange of population is not posited here, but a certain degree of intraregional migration is certainly indicated; and in any case, these figures underscore the paramount importance of the positive population growth in the river regions of the two states in the period.

In view of the shifts in the young adult population cited above, it is not surprising to find, in Table 28, that the rural counties of the river regions show consistently higher percentages of their populations in the age groups under 19 and over 60 than in the United States or in their respective states, while the percentiles of the groups from age 20 to 39 are consistently a good bit lower. The opposite is seen to hold true for the urbanized counties: their percentiles of persons under 20 and over 60 are less than the national average, while the percentiles of those in the prime working ages, 20-39, are higher.

Table 29 shows that, in keeping with the rest of the United States, the River Region counties were experiencing rapid urbanization in the decade 1950-60. Of the 32 counties studied, only Pulaski and Saline show a growth in their rural populations (coupled with very considerable urban growth); and of the counties with measurable urban populations only three--Johnson and Polk in Arkansas, LeFlore in Oklahoma--show loss in urban population. There is evidence in this table of considerable movement within the county from rural to urbanized areas. Ten primarily rural counties, all of which experienced absolute population loss between 1950 and 1960, show an increase in the urban component of their populations:

	Percent change total urban pop. 1950-60
Arkansas	
Crawford	+ 5.8
Logan	+52.7
Conway	+ 9.4
Faulkner	+13.7
White	+20.7
Arkansas	+25.3
Dallas	+ 3.6
Oklahoma	
Rogers	+20.8
Sequoyah	+16.2
Wagoner	+ 1.7

Needless to say, all of the highly urbanized counties of the region show urban increase.

The racial distribution of population in the River Region counties is shown in Table 30 for 1960 and is seen to be extremely varied. In general, those counties with exceptionally low percentiles of non-whites will be found in the hill country, while the agricultural counties with much higher percentiles of non-whites have large acreages of agricultural lowlands and most of these latter are in the eastern part of Arkansas, as the river approaches its delta. Again, the urbanized counties have higher non-white components. The relatively high non-white population of Sequoyah County in Oklahoma is largely Indian. Indians comprise almost 19% of the total non-white population of the seven Oklahoma counties and Sequoyah has the highest component of them. The aggregate non-white percentage for the 25 Arkansas counties was 18.1, while for the U.S. it was 11.43, and for all of Arkansas 24.4. Yet 11 of the 19 counties in the three eastern subregions show less than 5% non-white population. In the Ozark county of Cleburne, the 1960 census registered but a single non-white person. In Oklahoma, the 7-county region had 11.84% non-white population, barely above the U.S. figure and well above the Oklahoma figure of 9.5%.

Finally, levels of educational attainment of the river region's people are shown in Table 31 and are seen to be, for the non-urban counties, extraordinarily low. Nationally, in 1960, the median school years completed was 10.6, but only 8 of the 28 rural counties show a figure of 9.0 or better. Nationally, the percentage of people 25 and older with 8 or less years of schooling was 39.7, whereas in the rural counties this percentage ranges from 46.3 (Faulkner in Arkansas) to 68.7 (Haskell in Oklahoma). On the other hand, it is noteworthy that in each group of counties, the highest educational levels are shown for the most highly urbanized county, and in Tulsa and Pulaski counties these range well above the national average.

But it must be recalled that these 1960 figures from the rural counties represent a remnant population which had just experienced a decade of drastic out-migration heavily concentrated in its young adult, hence better educated age groups. And conversely, the urban counties reflect an in-migration of precisely these same "prime" groups. These remnant populations, as we have noted (Table 28), are heavily overweighted in the older-age categories, and similarly the aggregate figures for educational levels reflect a high proportion of survivors of the legendary "hillbilly" culture of the Ozarks and the Ouachitas. For example, there are to be found in all of these counties--and in the most highly urbanized counties as well--an astonishing number of persons who indicated in the 1960 census that they had completed 0.0 years of schooling. In Pulaski County (Little Rock), 1,760 persons, almost 1.5% of the population 25 and older, were so registered. It can be presumed that these are preponderantly persons in the highest age brackets, survivors of a hill culture in which schooling was neither mandatory, nor even customary, and very often simply not available. These remnant sectors heavily downgrade the aggregate educational levels of both the rural and the urban counties. Seen in this light, Tulsa's 1960 figure for median school years completed--12.1--indicates a very high level among the prime age groups 30 to 49, and the same is the case with Sebastian's 10.7 and Pulaski's 11.5.

Natural resources

Among the three basic inputs determining the level of economic activity for a region is natural resources, and for the region under study they comprise agricultural land, water, mineral resources and timber. Geographically, the major resource of any area is land, and in the Arkansas River Region a relatively high proportion of the land is productive--either as commercial forest, pasture, or cropland. Only in a few highly urban counties is there significant conversion of land to other types of use, and the main shift in land use is within the agricultural sector--from woodland to pasture and, to a less extent, to cropland. Water, both groundwater and surface water, is abundant throughout the region and sufficient for the foreseeable future, at least in terms of quantity. Mineral resources are of large importance in both Oklahoma and Arkansas, the major exportable items being fossil fuels in Oklahoma and bauxite/aluminum in Arkansas, although coal of competitive quality is mined in both states. Very considerable deposits of clays and gravels are worked in both states, largely for intrastate consumption. Timber stands are a valuable resource given continuing importance in all projections for the region, with a decrease in timber acreage and a shift from hardwoods to softwoods. These factors are briefly sketched for each state in the following overlook.

Oklahoma

Figure 3-4 shows that the entire length of the Arkansas River comprises a major groundwater reservoir and that all the counties of the impact region are served by local aquifers except for southern Latimer and LeFlore counties. Figure 3-5, showing the lakes of Oklahoma, existing and in formation, indicates that much of the surface water of the state is within the region. With the completion of dams along the Arkansas and Verdigris rivers and their ensuing reservoirs, this portion will be much greater. Rainfall in the area, necessary for reliable replenishment of these ground and surface supplies, is high, as indicated in Table 32. All potential needs for agricultural, industrial, domestic and recreational water can be expected to be satisfied by the construction features of the ARDP.

Figure 3-4

MAJOR GROUNDWATER RESERVOIRS IN OKLAHOMA

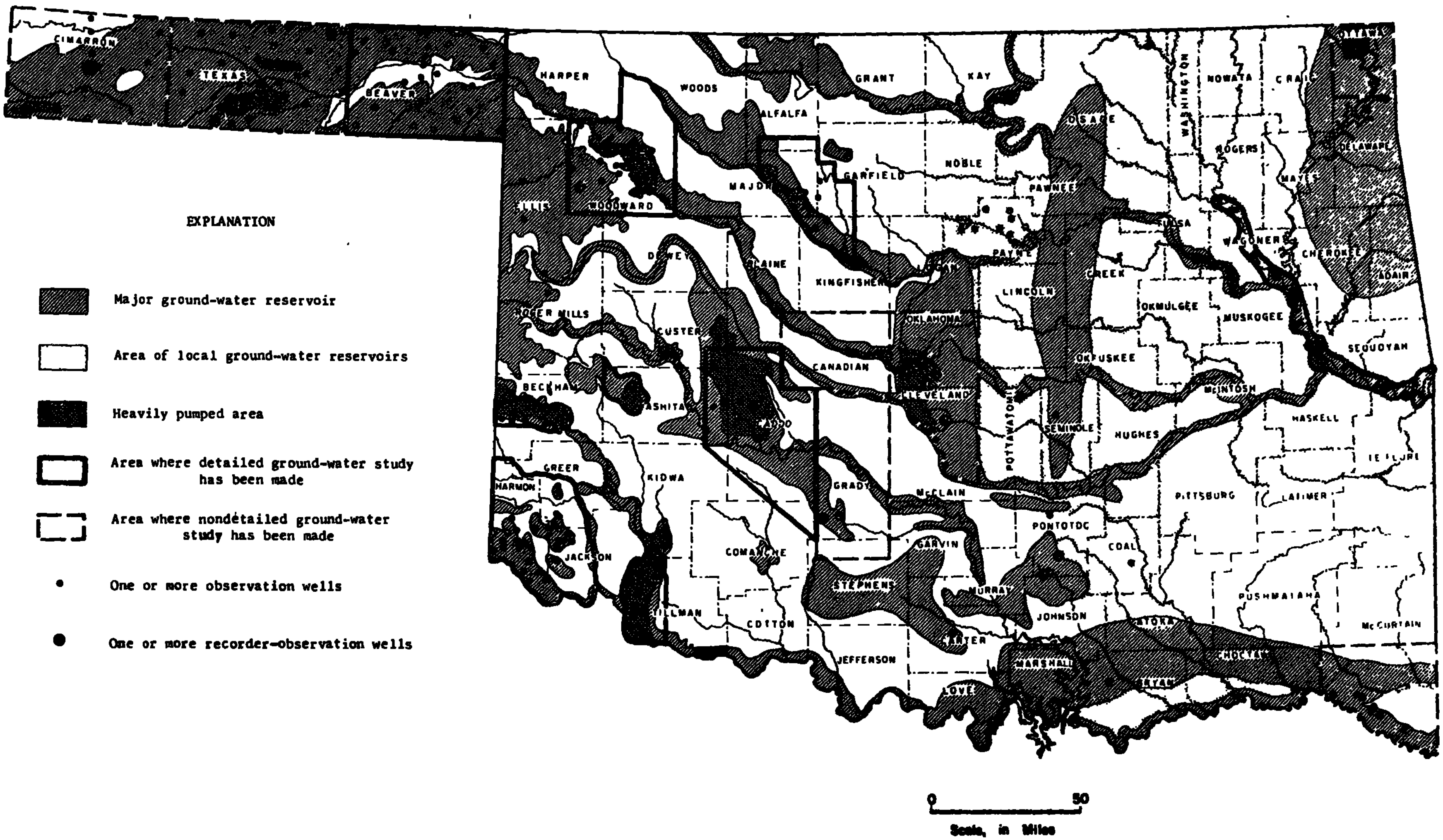
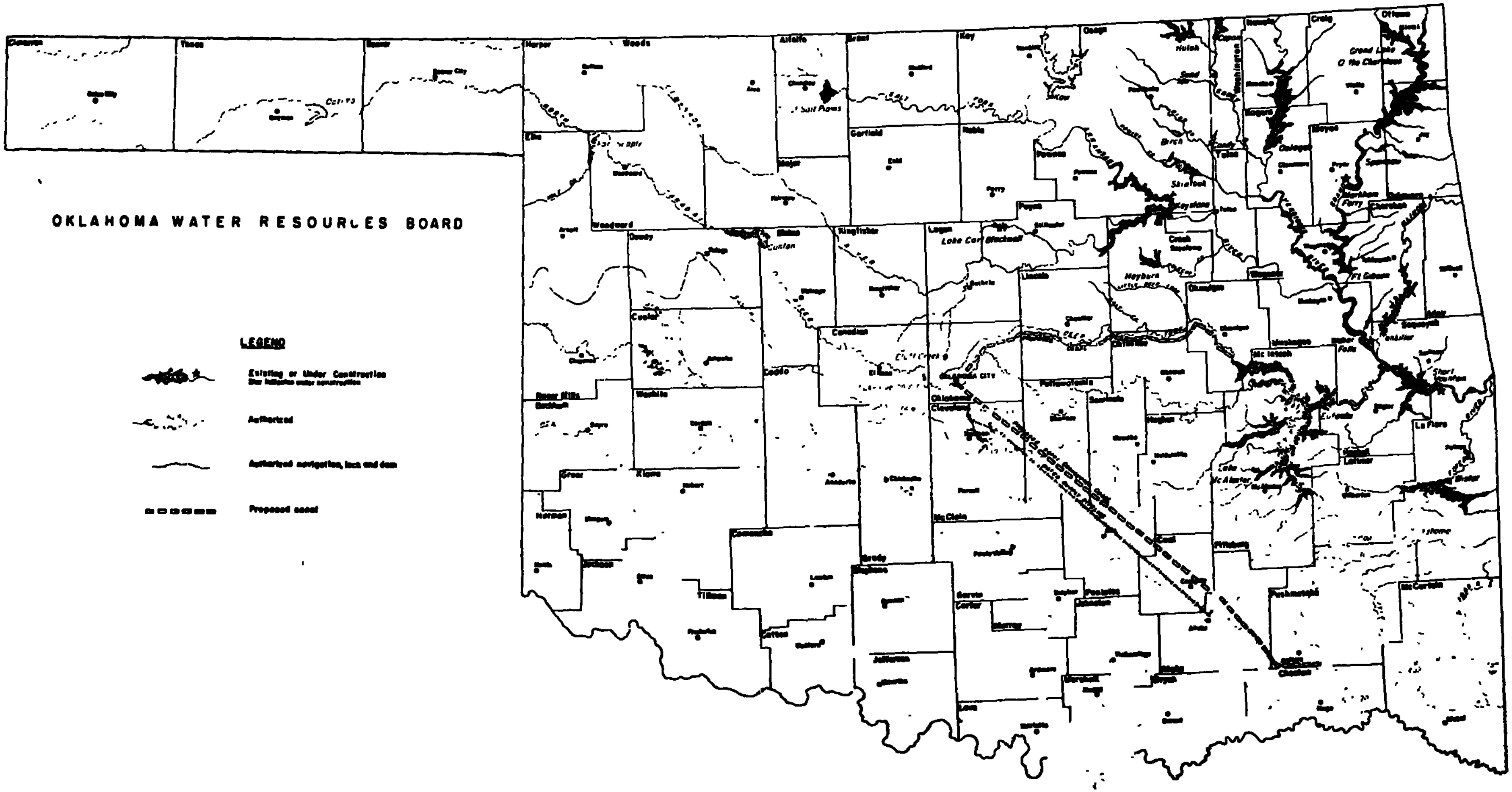


Figure 3-5

MAJOR LAKES IN OKLAHOMA



In 1964, about two thirds of the land area in the 6-county region was in farms, while Tulsa County had dropped to 50.5% in farms (from 97.6% in 1959). Moreover, as seen in Table 33, between 1950 and 1964 the acreage in farms had increased, in all the counties except Rogers, while the number of farms was reduced by more than one third. The result was a very considerable increase in the size of farms and a consequent increase in the average value per farm--a trend also observable throughout the state and the nation in the same period. Projections of land use within the region for 1975 (Table 34) anticipate an overall reduction of farmland of less than 2%, but also a considerable shift within that category from woodland to pasture and cropland, and from pasture itself to cropland. The shifts to cropland are particularly interesting in terms of ARDP impact, since frequently they involve use of formerly unavailable irrigation water.

The oil and gas fields of the 7-county region provide, as it is well known, a large portion of the region's productive output. They are a resource still in process of development and with very considerable proven reserves, but little if any impact from the ARDP is anticipated for the industry and it will not be detailed here. The hydrocarbon complex in the region has its own self-contained transport system of pipelines, and the only possible impact on transport would result from a competitive lowering of localized freight rates for tank trucks and tank cars in the face of available barge transport to railheads and highway interchanges downstream. Should a very considerable expansion of the industry occur, water specifically provided by the project might come into utilization in the refining process, which is calculated to require 18 barrels of water to produce one barrel of oil. In 1965, the 7-county region produced over 4 million barrels of oil with a value of almost $12 million, less than 2% of the Oklahoma production. This relatively minor share of the state production, coupled with the distribution pattern of consumption established for the region's output, makes very unlikely the development locally of a petrochemical complex--the only potential for the industry which might make significant use of the navigation facilities of the project.

But important as they are, the hydrocarbon resources of the area only about equal the value of the region's production of other minerals--coal, clays, stone and gravel (metallic mineral production in the area is insignificant). These mineral industries can benefit appreciably from the navigation features of the project, whether directly through low-cost barging or indirectly through competitive lowering of freight tariffs. The value of total mineral production in the 7 counties in 1964 was just under $34 million, while the 1965 value of oil and gas production was just under $18 million.

The 7 counties account for about two thirds of the Oklahoma production of coal, and they possess the same portion of known reserves. Production in the region declined by 50% between 1952 and 1965, a period of depressed prices for coal and, locally, of unfavorable freight rates. Both value and production have increased markedly since then, and a significant development in Haskell County is a large mining operation to provide coal for 50 new coke ovens producing metallurgical coke. This development, which must be directly credited as a project impact, opens the possibility of establishment within the region of steel production utilizing barged-in ores or scrap; in any event, failing this, the produced coke must be transported to steel-producing centers elsewhere. In terms of new types of industry within the region, as distinct from expansion of existing industries, the production of metallurgical coke seems to offer the most promise for possible large-scale use of the project's navigation features.

In 1965, the value of clay, stone, sand and gravel, lime and cement produced in the region was over $14 million. Reserves of these resources are adequate, and this considerable production--utilized largely within the regional market--may be expected to expand very significantly with the heightened level of economic activity throughout the river region anticipated as a result of the ARDP. These products are expected to make large use of the navigation features, and here, then, is a case of multiple direct impact from the project.

The major timber-producing counties of the Oklahoma region are Haskell, LeFlore (which is preeminent), Muskogee and Sequoyah. In 1955-56, almost 1.2 million acres--49.5% of their total land area--were in commercial forest in these four counties, but by 1966 this productive area had dropped to just over 1 million acres, 42.6% of the land area. At the same time, due to extensive upgrading of forestry practices, growing stock in the four counties increased from 278.3 million cubic feet to 285.7. A very considerable shift from hardwood species to the faster-growing softwoods also occurred during the decade, and the resource is now considered to be well-managed and capable of indefinitely prolonged and increasing utilization. Given this continued good management, however (that is, without exploitative "mining" of the stands), the timber yield cannot be greatly increased in response to an expected upsurge in the regional economy. With the continuing shift to softwoods, however, pulp production is expected to increase, as well as local paper production. One ton of paper is calculated to require 250 tons of water for its processing, and here again is a case where an industry will experience impact benefits both from industrial water supply and from navigational opportunities, since all forest products are particularly amenable to water transport.

Arkansas

Between 1960 and 1965, usage of surface water in the 25-county Arkansas region increased 52%, from 178 million gallons per day to 270 million, while groundwater use increased 33%, from approximately 385 million gallons per day to 513 million. On a region-wide basis, the presently available water resource is calculated to be adequate to a usage tenfold the present utilization. However, with greatly increased usage throughout the region, some local problems would arise, notably in the depletion of groundwater in the area northwest from Little Rock. The controversial effect of the project on the groundwater tables in the Delta area has been discussed above. These local difficulties mainly concern the development of irrigated agricultural acreage, however: the main increase is anticipated in industrial and domestic use of surface water directly along the river itself, and the increased and stable flow provided by the project is considered entirely adequate for all anticipated needs.

Agriculture is an important industry in the region, with over 5 million acres in farms in 1959--44.4% of the total land area--producing an aggregate income of $156.5 million. An average 2.3% growth rate was obtained in the period 1949-63 and is expected to hold fairly steady for the immediate future, with rapid increase anticipated only in the event of a shift in national policy encouraging production of food and grains for a world market, in which case significant growth in the production of rice and soybeans would occur.

Increases are anticipated in poultry production, and in commodities to supply newly established fruit and vegetable processing plants. In the west and central portions, cash crop production will probably decrease, due to inundation of cropland by project reservoirs, but it is anticipated that this loss will be repaired by an increase in pasture and consequent livestock production.

Agriculture throughout the region is expected to benefit by increased advantages in transport costs--both for imports by feed- and grain-using producers and for crops exported to nearby and world markets.

Table 35, showing characteristics of farms in the 25 counties in 1959 records a midway point in the transition to fewer, larger and more valuable farms already observed for the Oklahoma counties (Table 33). In 1964, the average farm holding in the Oklahoma region was 254.2 acres, an average size attained in 1959 by only 2 of the Arkansas counties--Prairie County, where the average size was 281.9 acres, and Arkansas County, where it was 370.7 acres. Both these counties are in the eastern half of the state, and farm size notably decreases as one proceeds westward along the river. Table 35 is mainly valuable for indicating the relative importance of farming in the various counties.

The value of mineral products produced within the river region in 1964 was about $51 million, representing 49% of the entire state's mineral production exclusive of crude oil, which is found only in the southern part of the state. This figure, however, does not indicate the true importance of mineral production to the regional economy, since three of the mineral resources--bauxite, coal and natural gas--are of such a nature that they are best utilized or processed locally, and so have a "multiplier" effect.

The United States is the leading producer and consumer of aluminum, yet it must import from foreign sources over 90% of its annual requirements of bauxite, the ore from which aluminum is produced. Saline and Pulaski counties have 98% of the domestic bauxite resource, but most of it is of low quality, containing over 8% silica and thus requiring a more complicated and expensive extractive process. This greater production cost can to a considerable extent be compensated by on-site processing, with the result that a complex involving extraction, reduction and manufacturing plants has developed within the region. Foreign bauxite is frequently blended with the local ores to reduce the silica content, and the existence of the complex may well lead to plants utilizing solely foreign ores. Thus, the navigation features of the project have large implication for this industry. Arkansas bauxite itself will not move on the river, but imported ores can be more economically moved upriver to the processing complex, while products based on the availability of alumina can be exported by barge. In 1964, the value of bauxite produced in the two counties was $17.5 million--but, again, it must be remembered that the importance of this resource to the local economy is many times greater.

The deposits of coal and natural gas within the region are shown on Figures 3-6 and 3-7, and it is immediately seen that they lie within the economically most "retarded" of the Arkansas subregions, along the western border with Oklahoma. Five of the six counties of the West Subregion are included in the resource area, although Johnson County in Central Subregion No. 1 is the major producer of coal. As in Oklahoma, the Arkansas field comprises the low volatile coal used for blending in the production of coke--a kind of deposit otherwise found domestically only in Virginia and West Virginia. The Arkansas deposits cannot compete in the general market with the cheaper and more easily mined high volatile types found in nearby states, but they have unique value for coke production and, as noted above, a large coke-producing plant is now being established in Haskell County, Oklahoma. This proximity, and the possibility it holds out for large-scale production, again underscores the need for bi-state planning for the western areas of

Coal Resources Areas

Figure 3-7

Location of Natural Gas Production

the Arkansas region--a need already noted in regard to the "problem" of Fort Smith. In 1965, the value of coal production in the region was $1,371,428--up slightly from 1964 but still well below former production levels.

In 1962, the last year for which figures are available, natural gas production in the region had a value of $7.5 million, but production was rapidly rising and in fact increased 10% in the following two years. Pipelines for export of the gas are only moderately developed, and the Arkansas Planning Commission has recommended that the considerable reserves still available for local consumption be so utilized. Thus, gas-using manufacture, such as fertilizer plants, could, with the present availability of low-cost barge transportation of their products, be attracted to on-site location, realizing appreciable economies in their fuel consumption. The local multiplier effect of this utilization of the resource makes it, of course, highly desirable from a planning standpoint; and the present availability of low-cost transportation, making it highly feasible, may be regarded as a direct project impact.

Sand and gravel production in the Arkansas subregions had a $3.25 million value in 1964 and represented entirely local use in construction. Reserves are adequate for all anticipated future needs; and, as in Oklahoma, increased production can be expected from a general heightening of economic activity. Only short-haul barge movement of these products is envisioned, although they could account for a good volume of river traffic.

Clay production in 1964 was valued at $1.5 million, three quarters of which came from high-alumina refractory clays found in Pulaski and Saline counties. These clays are relatively rare and highly exportable, and the industry should receive considerable benefit from the project's transport features. Other clays, of lesser minehead value but highly productive of multiplier effect, are used by plants in Johnson, Sebastian and Lonoke counties in the manufacture of structural clay products and lightweight aggregates--exportable items which will benefit from the navigation features.

Crushed and dimension stone, particularly from Central Subregion No. 2, has long been shipped to the lower Mississippi area by rail, and barge shipments to this market from more remote producing areas have been a competitive factor. Export of stone products, therefore, to the lower Mississippi is expected to increase markedly, as a result of this new competitive advantage, and to reach a volume of several hundred thousand tons annually of river traffic. In 1964, reported production of crushed and dimension stone in the region was valued at $15.5 million, of which $11.45 million came from Central Subregion No. 2.

Table 36 shows the distribution of these various mineral products throughout the Arkansas region and makes clear their particular importance to the Little Rock area. Developmentally, however, as we have noted, they have a strategic importance for the western counties not evident from this table.

Forest acreage in the 25-county region is, of course, many times that of the Oklahoma region, but the major portion of the commercial stands are in Dallas and Grant counties, in the coastal plains area south of the river in Central Subregion No. 3, while the nonindustrial private stands (many of which are found in the western upland area) are small and in need of management improvement. A slow growth is anticipated for the industry within the region, with little impact from the ARDP beyond possible reductions in transport costs. Timber stands in 1959 were about evenly divided between hardwoods and softwoods, while in the annual cut the ratio of softwoods to hardwoods was about 3 to 2. The demand for sawtimber, pulpwood and other forest products would, of course, increase with a heightened level of general economic activity, but significant early expansion is not looked for.

Manufacturing

The many aspects of rapid change in the economic base of the Arkansas River Region reviewed above all tend to reinforce the central importance of the establishment of new manufacturing industries in the two state regions. That is, existing industries, including agriculture, will continue to grow and will make a basic contribution to a heightened level of economic activity even as they become more capital-intensive; but they will not in themselves provide the kind of utilization either of human or of natural resources necessary to lift activity to a level of adequate response to the shift of population to urban centers. This impetus can come only from greatly increased industrialization--in the on-site processing and utilization of extractive commodities and products. It is precisely this kind of activity which accounts for the significant gains in manufacturing employment within the region in recent years,[1] but only the location of new types of secondary products and utilization, coupled with intensification of those already established, can

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[1]The remarkably rapid growth of manufacturing in the Arkansas River Region in the period 1954-63 is detailed in Table 37 in terms of value added. It is seen that the region as a whole more than doubled the U.S. growth rate in the period; and while this average rate is weighted with quite astonishing percentage increases from a very small base in several of the less urbanized counties, the rate of increase in the urban centers is also impressive. Thus, while value added by manufacture in the United States increased by 62.7% during the period, it increased by 112.9% in Sebastian County, by 165.8% in Pope County, by 120.8% in Pulaski County, and by 406.3% in Jefferson County. Comparable data are not available for Oklahoma, but equally remarkable percentage increases in manufacturing employment in the Oklahoma counties are detailed in Tables 5 through 11.

. . .

provide the stimulus needed to achieve the looked-for levels of economic vitality. A high degree of localized rationalization of available labor force, extractive production and markets will be called for, and in this process the lower transport costs expected to result from the ARDP, as well as the reliable supply of industrial water it provides, will have a measurable impact.

As pointed out by the Planning Commission of Arkansas in Volume IV of its report on the River Region, progress in the past along these lines indicates selectivity in the direction of capital-intensive types of production--factories exhibiting above average wage and value added levels, generally found within the fastest growing industries, such as metal goods, paper, chemicals and plastics plants. This kind of expansion is particularly appropriate for areas of low unemployment and with relatively high levels of skill and training in the labor force. It is also appropriate where local processing or utilization of a mineral resource is undertaken.

Except for this latter contingency, clearly the conditions conducive to capital-intensive expansion exist regionally only in the already highly urbanized centers. In a majority of the region's communities, the establishment of labor-oriented types of plants will be of central importance. Such manufactures as food processing, apparel and wood products, while they have lower growth rates, are appropriate to areas of high unemployment, relatively unskilled labor force and plentiful timber resources and farm production--a capsule description of many of the region's rural counties.

An overview of cultural traits and migration

The economic and physical characteristics of the region, reviewed statistically in the foregoing and observed at various moments in a period of rapid transition, inevitably register a total impact on the social structures and cultural attitudes of the region's people, its most overt manifestation being, of course, in the large migration of individuals from rural communities and to urban communities.

In the following section, we shall examine some of these nonstatistical aspects of change and the possible relevance of the ARDP as a factor of measurable influence on them. We will be looking at selected aspects of cultural patterns in the two states, especially Arkansas, and their relationship to migration.

Outsiders have not been attracted to these states as sites of cultural study; most of the available material comes from the departments of sociology in the local universities and from special reports prepared by urban and statewide planning bodies. A certain amount of social and cultural data exists on computer tapes and unpublished tabulations in state offices and planning bodies, and this should be utilized in future study.

Since it is likely that the major impact will derive from urbanization and industrialization, the population probably undergoing most extensive alteration of traditional experiences is the rural. These people will continue to migrate to urban centers, where they will contribute the major portion of the increment of future increase, and it will be useful to know something about their general culture, especially 1) the general level of living; 2) social stratification; and 3) values and aspirations. Our presentation, as we have indicated, is an overview of the general situation, not definitive.

For detailed and continuing assessment of change, more studies will have to be made of the existing literature, and in the field as well, to establish firmer cultural baselines.

At the outset, significant differences in broad cultural orientations are observable in the two states. These can be summarized by noting that Oklahomans consider themselves to be "Westerners" as well as Oklahomans, while Arkansans think of themselves solely as "Arkansans." That is, people in Oklahoma, while lacking a special state identity (one local newspaper pundit called the historic Rogers-Hart musical "the greatest boost a forgotten state ever got"), conceive of themselves as belonging to a cultural pattern beyond the state--the large Western tradition, with its rodeos, its limitless horizons, its cowboy gear, with Will Rogers a kind of lay saint. This is important: Oklahomans stand tall, so to speak. They are Westerners, but of a distinctive kind, the Will Rogers type, as free-ranging in mind as in body. The large Indian population, and its distinctive history, also contributes to this Western identity as the primary reference point for cultural tradition. It helps account for the enhanced sense of the booster spirit one feels in Oklahoma and which appears to inspire the (perhaps) more aggressive pursuit of such development efforts as the ARDP than is the case of Arkansas.

In the estimation of her citizens, Arkansas is not part of the West (although, of course, rodeos are held). But then she is also not a part of any other clearly defined section, either--except possibly of the Middle South, or Border country. She is, in the consciousness of most of her citizens, unique: she is the State of Arkan<u>saw</u> (NOT to be pronounced Ar<u>kan</u>sass, in the hoary yet symbolic joke). Her ethos is rural; twangy; Bob Burns, not

Will Robers, a significantly different style of humor. Rogers "stood tall" and established the fact that the Oklahoman had a view of the world and of man; Burns was intensely local, small-scale, kinship-dominated in his comic range. This image of the mountain boy, an Ozark character with the drawl of the porch-sitter, is the wellspring of the Arkansas spirit; an inbred orientation, a canny resistance to the newfangled which, depending on the point of view, may be regarded as shrewdness or backwardness. Grafted onto this basic cultural stock in recent years has been the Rockefeller phenomenon, the scion of Eastcoast wealth and sophistication pushing his chosen state--like the Shah of Iran--toward the modern world.

Perhaps much derives from the urban atmospheres which dominate the two states, Tulsa for Oklahoma and Little Rock for Arkansas. Both are large and progressive cities, but Tulsa much more so, by any index. Tulsa, like Dallas, infects the state with its drive. Little Rock, until recently, has been a sleepy provincial capital, somewhat like Lexington, Kentucky.

In both states minorities have played a special role: the Indian in Oklahoma; the Negro in Arkansas. The ways in which these groups have been dealt with and the contributions they have made to the ethos (and guilt complex) of the white citizenry help to differentiate the two cultures. For Oklahoma, it is the Western notion of the noble Red Man--subject, of course, to a considerable degree of tacit exploitation and certainly not acceptable in the best circles. For Arkansas, it is the Negro, seen as a largely inferior race, but capable of advancement when encouraged (a stance typical of the Border states). Indians are in Oklahoma to stay, and they have gradually filtered into all parts of the class pyramid. The Negro population of Arkansas is low-income and increasingly concentrated in the cities--large-scale commercial farming having driven out tne Negro smallholder and tenant farmer here, as in most states like it.

Level of living

Earlier, we defined the states' low-income areas, noting that they extended beyond the River Region of our particular study. But since these low-income areas supply a large portion of the labor force for new industries, it is important to comprehend the style of life of these people, recalling at the same time that levels of aspiration generally rise when rural migrants from poverty areas move to the city.

To define these styles, we have used data from the Ozark and from low-income counties in other areas of Arkansas as our sample for rural cultures; for the urban pattern, we have used data from surveys carried out in Tulsa. We begin with the rural data:

> One is accustomed to hearing that Arkansas is a poor and undeveloped state, ranking about 48th in every category except, perhaps, federal assistance. Yet it is sometimes difficult to convince even one's colleagues that an Arkansas undergoing rapid industrial and urban change is still predominantly a two-class society. The facts are quite clear on this point, however. In 1960, the last full census data available, only 10 per cent of the work force made over \$10,000 a year; only three in ten made over \$6,000. Although the employment profile has steadily improved over the decade with about 700,000 persons of the two million total population now in the work force, most of these gains have been made through the addition of 150,000 minimum wage jobs in manufacturing industries and allied service crafts. While these gains are a welcome improvement in the earning power of an unskilled, unemployed, and underemployed work force, the minimum wages earned in such jobs do not compare favorably with advances in the national per capita personal income. For the last four years there has been an increasing "dollar gap" between the national per capita personal income and that in Arkansas.

> Furthermore, there is little reason for optimism about the potential career mobility of a work force with a median educational level of 8.9 years for employed adults 25 years and older.[1]

The report from which the foregoing is quoted provides ethnographic detail concerning the home environments of Arkansas children in the poorer parts of the state, especially the Ozarks, the general culture of the rural communities, and the state of public facilities for handling family troubles and dependent children.

The report also sketches the level of culture in these Ozark communities: the prevalence of superstition (a case of witchcraft, involving the beating of female suspects, was nationally reported in 1969); the frequency of domestic violence, especially child abuse; delinquency; probable high rates of mental illness in certain groups. These phenomena are all most frequent in the poverty income groups ($3000 per year and below).[2]

This is not to imply there are no redeeming qualities in the lives of these people, and it is recognized that human existence can be worked out in other than middle class terms. However, it is suggested that people with a background of this type are liable to get into trouble in urban environments, and will constitute a focus on social change.

A recent survey of housing in the Arkansas Ozarks[3] (about 1/2 the state's area) found that 60% of the area's population lived in country or village housing which was poor compared to urban housing in the Ozark region itself, yet considerable improvement was noted between 1950 and 1960 data (Table 38).

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[1]Quoted from: K. Rice, Consultative Report on the Contribution of the Johnny Cake Child Study Center to the Residential Child Care System in Arkansas. Human Resources Center, University of Pennsylvania, 1970.

[2]For surveys of the economic and social level of the Ozarks, see: Arkansas Preliminary Plan for Economic Development in the Ozarks. Arkansas Planning Commission, 1969.

[3]Rural Housing Conditions in the Ozarks. Agricultural Experiment Station, University of Arkansas, Bulletin 736, 1968.

Almost half the rural houses in 1960 were considered to be sound or slipping, with all plumbing, whereas only 16% could be so considered on the basis of 1950 census data. In other improvement categories, however--basements, access to pure public water supply, garages, central heating, etc.--the condition of housing showed less amelioration between 1950 and 1960. The pattern of change was thus the same as elsewhere throughout the nation--upgrading begins with plumbing and electricity--and by 1960 the housing in this poorest part of Arkansas, source of a large portion of the urban in-migrants, had reached the first plateau of improvement, by urban standards.

An index of rural level of living which samples a scattering of poor areas throughout most of Arkansas uses the "county school district"--a unique creation of state law in 1949 (Fig. 3-8).. This law took account of the poverty and sparse population in many rural areas, unable to afford local districts, by permitting them ("requiring", in the official term) to form larger school districts, pooling their resources--essentially a specialized form of consolidation. Arkansas now has 32 of these "extremely rural, relatively isolated" districts,[1] some of which are in the river region (see Fig. 3-8).

These districts, which may usually be taken as convenient geographical representations of the poorest rural areas (Saline County is an obvious exception), experienced a 7 percent drop in enrollment between 1960 and 1964, in itself a convenient index of the amount of out-migration from these poorest rural districts. The quality of education provided was judged by the study to be inferior to that provided by regular "independent" districts, with

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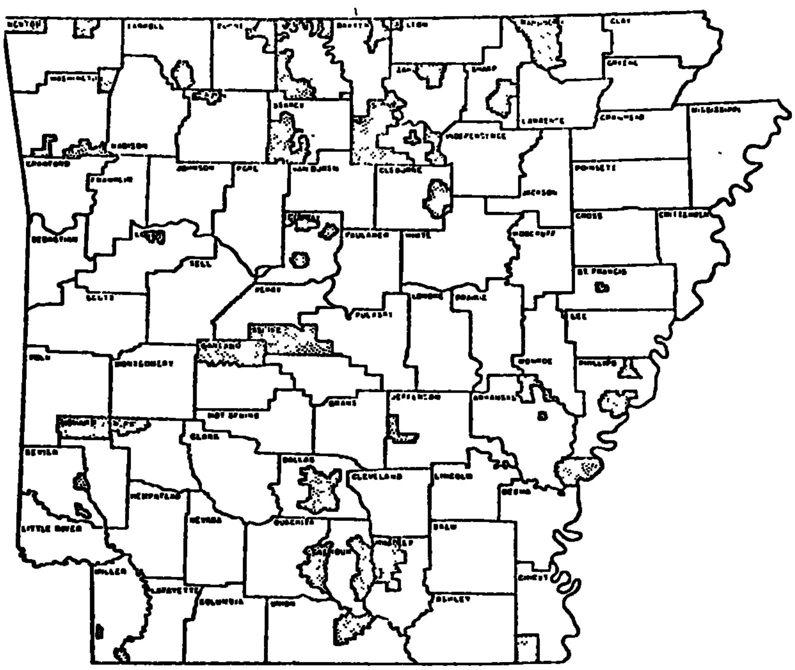
[1]Analysis of County School Districts in Arkansas, Agricultural Experiment Station, University of Arkansas, Bulletin 371, 1968.

Figure 3-8

COUNTY SCHOOL DISTRICTS, ARKANSAS
1964



Source: Arkansas Experiment Station, Bulletin 731.

split-term sessions, poorly paid staff, and high number of grades per teacher (although, naturally, the number of pupils per teacher is lower than in the other school systems). Financial problems of these districts, sharpened by increasing loss of population, make the situation irrecoverable without state subsidy or a shift to a completely different kind of operation. The study presents a dismal picture of education in these rural poverty districts, whence many pupils have already joined the state's urban population.

Regular public welfare reports for Arkansas provide data on quantitative aspects of welfare. In 1970, 58 counties out of the total of 76 were participating in the Food Stamp program, and 17 in the Surplus Commodity Distribution program--twice or more the number of counties in these programs in Missouri, also an Ozark highland area in many respects. The Arkansas counties involved were mainly in the north and south-central parts of the state. In this instance, as in others, the poverty areas requiring most assistance are not to be found directly along the Arkansas River.

Turning to the urban situation, we can draw from a recent study of living levels and aspirations of a low-income district of Tulsa, targeted for urban renewal.[1] This study, utilizing objective criteria wherever possible, is a model for research on the culture of rural in-migrants to urban areas. Respondents were asked detailed questions concerning their experiences, needs, worries, and equipment in categories comprising health, personal development and adjustment, home conditions, legal services, transportation, and information media. It provided detailed inventories of all living-level factors and of household budgets.

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[1]The Westbank Area II Urban Renewal Project: Report of the Diagnostic Survey, Community Service Council of Greater Tulsa, 1969.

The study noted that "the needs, problems, and desires..were more characteristic of people living in a small town," than of city-dwellers. That is, their concerns centered around neighborhood, kin groups, simple pleasures, and facilities which would provide qualities of life typical of a small community: a family doctor, people to take care of the children, social centers and taverns, and the like. Only 50% of the sampled population saw a daily or weekly newspaper. A majority stated that they missed the personal aspect of rural life and felt that services to make up for this lack should be provided. At the same time, there was no strong sense of deprivation, although this was apparently growing (most respondents represented the first generation to move to the city). The report concluded that urban renewal was not what these people needed, but rather the distinctive kinds of social services they lacked, and that if such services were not provided--or if urban renewal raised aspiration levels without satisfying the fundamental needs--problems of social order could be anticipated.

Municipal services meeting needs of this kind are almost nonexistent in Oklahoma cities, which lack even minimal attempts at providing neighborhood centers and the like. Services in general are poorly developed in both Oklahoma and Arkansas: The Arkansas Municipal League notes that "Arkansas towns and cities have been limited to a 5-mill tax for general purposes since the Constitution of 1874...(and) a 5-mill tax for capital improvement since 1926. These millages are collected on only a 20% assessment. These limitations are the most stringent of any state in the Union." The League's report goes on to ask for an additional $12.5 million for operating needs alone: "This is a conservative figure. It was obtained by questionnaires sent to all mayors asking for their 1964 budgets and estimated needs for 1965. Most of the... officials were conservative...services would still be below the national average.[1]

Municipalities in Arkansas are barred from receiving state tax revenue in all categories save gasoline tax and car license fees, and cannot levy local auto license fees. In both Oklahoma and Arkansas, the state economic development plans permit companies entering the state to forego payment of all taxes for 3 years, pushing the burden of support for this period on the impoverished communities. Also, many industries locate just outside city limits, preventing the city itself from levying taxes.

Clearly, important readjustments in public financing are overdue in both states if they are to match the expected developmental benefits with increased demands in services and levels of living.

Social stratification

The rural regions of Arkansas and Oklahoma possess a traditional social structure reflecting generations of inequality based on land ownership. Although never adequately acknowledged by rural sociologists, the social hierarchy of rural North America is rooted in the institutions of land tenure, with prestige and power based on one's standing in the tenure system--recognizing, of course, that in the local community anomalies will exist, especially in the area of personal prestige, where an outstanding individual's

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[1]For a listing of services available in Tulsa, see: Tulsa Model Cities Program, City Demonstration Agency, Tulsa, Appendix, 1969. The state of health of low-income groups in Tulsa is defined in: Health Interview Survey, County Health Dept., Tulsa City/County, 1969.

qualities may modify his status. But overall, social stratification is determined by relationship to the land.

Throughout rural Arkansas and the farming areas of southern and eastern Oklahoma (the ranching situation in the west differs, but is not within the geographical area of our concern), the land tenure hierarchy consists of owner-operators, renters, and sharecroppers, each divided into subgroups depending on the amount of land owned or controlled, or the nature of use agreements. The pattern extends to control of the social system in villages and small towns, with their retired farmers and businesses owned or controlled by members of owner-operator farm families.

The people most likely to migrate from rural regions toward urban areas are those with the smallest amount of land, whether owned, rented or cropped, or those who own no land and are renters or sharecroppers.

In a study of these groups' social participation made in the mid-1950s and repeated in part at intervals (mainly in southeastern Arkansas),[1] the Agricultural Experiment Station of the University of Arkansas found that the "crossing of tenure lines" in marriage was rarer than might be expected from the level of mixed association in casual visiting--that is, the tenure classes (and particularly when the amount of land controlled is great) are largely endogamous groups. It was also found that even when sons of renter-sharecroppers rise in the tenure ladder and acquire their own farms, there is less probability they will marry into their new tenure group than into that of their fathers.

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[1] Social Aspects of Farm Ownership and Tenancy in the Arkansas Coastal Plain, Agricultural Experiment Station, University of Arkansas, Bulletin 545, 1955.

The social participation data indicate that: 1) owner-operators attended school longer than the other groups, especially beyond elementary grades; 2) have more contact with people outside the kin group; 3) vote oftener at local elections; are more likely to belong to farm organizations; are more active in civic affairs. On the other hand, renters were more active in co-operatives, and the children of renters and sharecroppers sometimes were more active in 4H clubs and similar youth organizations than owner-operator children (the owner children being more likely to get involved in urban-oriented groups due to their more advanced educational and occupational objectives).

These profiles, plus the data from the Tulsa study, indicate what every city that has received rural migrants from the mountain and Middle-South Border states has learned: that these people are inclined to form enclaved communities in the city, seeking the personal quality of life they had known in the country; but also that they are apt to "run wild," seeking urban gratifications denied them in their rural status. They are poorly educated and in general ill-prepared for the complex dealings with government and other institutions required of a city wage earner. They are equally not equipped to avail themselves of the institutionalized advantages of city life. Their life experience makes it difficult for them to develop a sense of possession and concern for their residences; and the alienation they feel renders them unable to think of the city as a home. These patterns have altered somewhat in recent years, as the in-migrants have included more members of the owner class. However, for states like Arkansas and Oklahoma, with much of their population still in the rural areas, the problem requires continual study and preparation on the part of the receiving environments.

Values and aspirations

If we inspect studies of the values and attitudes of rural people, kindred phenomena emerge. A recent study in one of the counties of the river region[1] provides a close look at the values profile, stratified by tenure status groups.

The report found a close similarity of all groups except the owner-operator category, which approximated the profile developed in a study of Washington State farmers, scoring relatively high on "innovation proneness," "primary group preference," and "economic motivation" scales. However, they scored much higher than the Washington sample on "preference for rural life"--a finding consistent with the extreme localism typical of Arkansas and states like it.

Interpreting the results, the report notes that "traditional ways" of farming and living are given more weight in the tenant-sharecropper-village groups than in the more commercialized farming areas, with their market-oriented owner farmers, and townspeople. The lower status groups also appeared to give greater emphasis to the "frontier" notions of freedom from debt, self-sufficiency, and a simple level of living. However, the lower scores among these people on "preference for rural life" requires explanation. The report interprets this as being due to their sensitivity to the low income of farming, the factor around which most of the "dislike" responses centered. In other words, the attachment of these people to rural life is qualified by their dissatisfaction with farming as an occupation, and in questions where this comes into focus, there is a halo effect toward rural life in general. Somewhere in this zone of attitudes lie the major motivations for out-migration toward urban occupations and wages. Only 15% of all respondents stated that they

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[1]Attitudes and Values in a Rural Development Area: Van Buren County, Arkansas, Agricultural Experiment Station, University of Arkansas, Bulletin 650, 1962.

would specifically advise their children to stay in farming, and 54% stated definitely that they would prepare their children for some other occupation (21% said this was something children should decide for themselves; only 6% stated they would advise farming as a career).

Respondents in this study were also asked to rank life goals on a prepared list. Most respondents put "education for the children" first on the list, and "being known in the community as a successful man" last. "Owning my farm free of debt" was uniformly high, and all respondents gave land ownership a high mark in informal responses as well. A major deviation occurred in the lowest income group, who ranked "having modern conveniences in the home" last, whereas other groups placed it in the middle or higher. This conforms to the general deprivation pattern in lifeways characteristic of these people. In a study of rural high school boys in Arkansas,[1] Jordan et al. used a battery of tests and questionnaires to "relate aspirations, capabilities, and the discrepancy between them to the experience background of the youths...and to relate the youths' occupational plans to present and projected labor requirements."[2] The study was done in two low-income counties, one of them included in the West Subregion of our study.

The most general finding was that the occupational aspirations of the male high school students were not significantly different from those found for high schoolers in high-income, urban areas in Michigan. This finding

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[1] Aspirations and Capabilities of Rural Youth. Agricultural Experiment Station, University of Arkansas, Bulletin 722, 1967.

[2] Op. cit., p. 31.

seems to contradict the low-level cultural aspirations of impoverished rural groups indicated in the study previously cited; but it must be remembered that the previous study encompassed all age groups whereas the present one is confined to young males whose very presence in high school indicates an aspiration level probably higher than that of their parents, and who are very likely to identify with boys from higher-income families.

However, the second major finding was that the youths' capabilities were not up to their aspiration level. Their reading skills were below national norms, a fact reflected in their scores on other tests requiring reading ability to acquire information. Nearly 42% of the students chose professional, technical and related occupations, while the need projected for 1970 in these categories was only about 14% of the work force. Farming goals were in a minority, but even these were slightly higher than the projected need for farmers. The study concluded that there was no need for counseling to upgrade aspirations, but considerable need for better instruction.[1]

The report has several facets: It implies that a high quotient of dissatisfaction will emerge in these young people, particularly if they migrate--feelings of promises not kept and privileges denied. It suggests that the present and future young in-migrants, with higher education levels and greater expectations than their precursors, will appear less in the "hillbilly category and more in the familiar national group of restless middle-class youth.

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[1]For a survey of the current status of technical education in Arkansas, see: F. H. Troutman, Vocational-Technical Education in Arkansas. University of Arkansas, College of Business Administration. 1970.

Moving to college students, we have a study by C. E. Venus.[1] This report, also the best brief analysis of migration out of the state, shows that Arkansas has been producing workers at a faster rate than the nation as a whole, while her economic opportunities, though growing, have not been sufficient to utilize all this labor--hence, migration. The ARDP presumably will serve as a retaining force, reducing this out-migration from the state, for the exodus was geared to changes in the occupational structure within Arkansas itself. As noted above, farming employment between 1940 and 1960 experienced progressively drastic losses, while medium-and-lower skilled jobs in industry and service trades gained as markedly, particularly in the period 1940-50. Many of the excess rural people, with agricultural skills or village-type business backgrounds, found it easier to leave the state than to try to enter the local urban labor force.

Turning to graduates of Arkansas colleges, we find that 49% of them remained within the state during the period 1953-62, while approximately half of those who left went to immediately surrounding states. The figures for this particular out-migration are shown to have a high degree of correlation with job opportunities for college graduates: that is, Arkansas does not have a "brain drain" (at least not by 1962). The state has kept everyone it can find a job for. Moreover, there was a good bit of departure and return: some of the 49% who "stayed" had actually left, got experience, then returned to Arkansas, usually in better jobs. By 1962, this group was increasing in size and there were also indications that job shortages were beginning to emerge in some of

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[1] <u>Arkansas College Graduate Emigration</u>. University of Arkansas, College of Business Administration. 1965.

the college-trained areas--all evidence that more than 49% of graduates would be retained in subsequent years. This is, of course, another index of continuing development.

But the study also found that the better the college the greater the number of its graduates who would leave, a fact which seems associated with a series of "image" factors which emerge in the Venus study. Thus, if the graduate sees the state as stagnant, he will be more inclined to leave; similarly, if he has high ambitions, he will be unlikely to imagine that they could be satisfied in Arkansas--indeed, over half the migrants did not see the state as providing them with a "satisfactory" job. Again, 80% of all graduates felt that Arkansas wages were lower than in other states. Venus notes that these negative opinions--reinforced by job-seeking experience--become rationalizations for migration and get built into the age-group culture, and so are passed on. Thus, he feels, migration may continue at a relatively high rate despite improvement in the local occupation market. It will be of interest to see if the ARDP can contribute measurably to overcoming this persistent negativism.

We have already had occasion, in this overview of the region, to speak of the labor surplus which exists in the region and in the adjacent "Ozark low-income area," out of which labor may be expected to come if industrial growth in the Arkansas River Region should continue to be substantial. Sandmeyer and Warner (see earlier ref., pp. 5-6) found in 1968 that a net loss in male employment of 100,000 jobs had been registered in this larger region--the very considerable gains in nonagricultural employment having failed to that extent to match the greater decline in farm jobs. The characteristics of this under-utilized labor force, as we have noted, suggests the need for labor-intensive types of new manufacturing as well as the fast-growth capital-intensive types upon which developmental emphasis has been placed to date. These considerations, clearly, carry sociological implications. A need for training facilities in both types of plants is obvious, and an enlarged sphere of union activity can be anticipated among the labor-intensive workers--since the very attraction to new industries of this kind is the availability of low-cost labor.

Expansion of labor-intensive industry will also tend to accentuate what sociologists in Arkansas and Oklahoma are referring to as a "dollar gap"--a fairly imprecise term designating a new, somewhat higher wage and living level for poorly trained rural labor, a plateau from which it is extremely difficult to rise. This mechanism has already, in their opinion, raised aspirations and expectations which will make their contributions--perhaps painful--to social change.

In summary: if urban-industrial areas in the Arkansas River Region are to receive additional numbers of rural people, there will be continuing need for attention to socialization of these people in urban ways and culture, as well as job training programs. It has also been noted that some of the poorest parts of both Oklahoma and Arkansas are not directly involved in the designated river region, and development in these areas will have to follow patterns already established--namely, the economic development districts system now in force in both states. The question should seriously be confronted, whether it is not advisable to promote kinds of development within the rural areas which can perhaps reduce the cityward flow of people so intensely oriented to rural living, so ill-equipped either to contribute to urban development or to profit from it. Thus, while the ARDP will probably assist the two states generally in retaining their most valuable resource, people, its effects might be negative with respect to the distribution of population within the state. With respect to the better-educated, it seems clear that if jobs materialize more of them will remain in their home state. But it seems equally clear that the urban centers will continue to be the prime attraction, pulling the educated as well as the uneducated out of the rural communities and smaller towns.

There is, therefore, nothing in the ARDP which will directly, by plan, modify the cultural and social patterns of the state, other than to accentuate patterns and movements now visible. However, rising income levels are often diffused over a large geographic area, when they appear significantly in one portion, and presumably something of this sort would accompany the ARDP, as it has already been taking place since World War II.

Table III-1

Annual Average Unemployment Rates, By County, 1960-1965
(Per Cent)

COUNTY	1960	1961	1962	1963	1964	1965
Haskell	N.A.	N.A.	22.1	20.9	20.1	15.1
LeFlore	16.0	17.4	14.4	14.5	13.5	9.9
Muskogee	8.9	10.8	10.5	10.4	9.2	8.0
Rogers	9.6	15.2	10.7	12.9	9.1	6.9
Sequoyah	N.A.	N.A.	12.9	10.4	11.8	10.9
Tulsa[1]	4.8	6.0	5.0	5.3	4.3	3.8
Wagoner	14.5	20.8	17.0	16.5	14.8	12.3
State of Oklahoma	4.9	5.9	5.1	5.1	4.7	4.2

[1]Tulsa Metropolitan Area--Tulsa, Creek, and Osage Counties.

SOURCE: Handbook of Oklahoma Employment Statistics, 1939-1965, and Handbook of Labor Force Data for Selected Areas of Oklahoma, Volume I, 1952-1963, and Volume II, 1964-1965.

Table III-2

Unemployment Rates in the Arkansas River Region of Arkansas

	Civilian Labor Force	Annual Average Unemployment Rates (Percent of Civilian Labor Force)		
	1963	1958	1960	1963
United States		6.8	5.6	5.7
Arkansas (State)	644,100	7.5	6.1	5.1
River Region Counties:				
Pulaski	109,700	5.6	3.9	3.0
Sebastian	35,750	6.1	6.8	4.4
Jefferson	29,625	9.8	6.0	5.1
Pope and Yell	11,950	10.5	9.1	6.7
White	10,825	17.4	13.0	13.6
Arkansas	9,300	N.A.	4.4	4.6
Faulkner	8,725	11.2	8.8	7.7
Saline	8,425	N.A.	N.A.	4.2
Lonoke	5,950	N.A.	N.A.	5.0
Conway and Perry	5,425	12.3	8.7	9.7
Logan	4,800	15.6	13.2	8.9
Crawford	4,625	19.9	19.2	15.1
Polk	3,700	8.9	10.3	14.2
Johnson	3,525	12.3	9.1	9.9
Dallas	3,425	7.1	4.8	3.6
Prairie	2,975	N.A.	N.A.	3.4
Franklin	2,900	14.5	13.8	13.8
Scott	2,250	8.1	7.7	7.8
Grant	1,800	9.2	5.6	6.9
Cleveland	1,200	20.8	11.5	10.4
Lincoln	N.A.			
Cleburne	N.A.			
Van Buren	N.A.			

N.A.--Not available.

Sources: U.S. Department of Commerce, Office of Business Economics, Business Statistics, 1963 Edition, p. 65; U.S. Department of Commerce, Survey of Current Business, April, 1965, p. 5-12; and Arkansas Department of Labor, Employment Security Division, Labor Force Data, Arkansas and Selected Areas, 1949-1962 and Supplement I for 1963.

Table III-3

Percentage Distribution of Employment By Major Industry, By County, 1960

COUNTY	Total	Agri.	Mining	Constr.	Mfg.	Trade	Finance	Transp.	Comm. & P.U.	Services	Govt.	Other
Haskell	100.0	24.2	5.7	8.0	7.4	21.1	1.8	1.7	2.6	17.1	5.4	4.9
LeFlore	100.0	14.2	2.9	8.7	16.2	19.4	1.9	5.3	2.4	20.4	4.5	4.2
Muskogee	100.0	7.3	1.0	7.0	14.8	21.7	4.0	4.5	3.0	25.5	6.5	4.7
Rogers	100.0	11.6	6.1	12.4	14.4	18.4	2.6	4.9	2.3	18.6	3.5	5.2
Sequoyah	100.0	14.3	1.8	6.6	25.4	20.4	.6	4.0	1.7	16.4	2.8	5.9
Wagoner	100.0	19.9	2.2	10.3	14.3	21.8	1.8	3.1	2.2	17.0	3.6	3.8
6-County Total	100.0	11.8	2.5	8.4	15.6	20.7	2.8	4.4	2.6	21.5	5.0	4.7
Tulsa	100.0	1.2	4.4	6.3	20.8	21.6	5.1	6.9	3.2	20.1	3.1	7.4
7-County Total	100.0	3.9	3.9	6.8	19.4	21.3	4.5	6.25	3.1	20.5	3.6	6.7
State of Oklahoma	100.0	9.4	4.5	7.2	13.2	21.0	3.7	4.1	3.0	20.7	7.1	6.1
U. S.	100.0	6.7	1.0	5.9	27.1	18.2	4.2	4.2	2.7	19.6	5.0	5.4

Source: R. L. Sandmeyer and L. B. Warner, Determinants of Labor Force Participation Rates with Special References to the Ozark Low-Income Area, Research Foundation, Oklahoma State University, 1968, Table 82.

Table III-4

Employment and Percentage Changes in the Arkansas River Region of Arkansas, 1940, 1950, and 1960

Industry	1940	1950	1960	Percentage Changes 1940-1960	Percentage Changes 1950-1960
Agriculture, forestry, and fisheries	85,261	60,576	25,232	-70.4	-58.3
Mining	2,605	3,218	1,706	-34.5	-47.0
Construction	7,203	14,470	17,081	137.1	18.0
Manufacturing	22,898	35,730	49,302	114.9	37.7
Transportation, communication and public utilities	12,169	17,915	17,632	44.9	-1.6
Wholesale and retail trade	28,444	43,253	45,675	60.6	5.6
Finance, insurance, and real estate	3,913	5,780	8,300	112.1	43.6
Services[a]	35,603[a]	35,266	45,411	N.A.	28.8
Government (total civilian)	7,048	16,085	19,752	180.2	22.8
Public education	N.A.	7,832	9,409	N.A.	20.1
Public administration	7,048	8,253	10,343	46.8	25.3
Industry not reported	2,736	4,365	7,565	176.5	73.3
Total--all industries	207,880	236,658	237,557	14.3	0.4

N.A.--Not available.

[a]Services included public education in 1940.

Sources: U.S. Department of Commerce, Bureau of Census, Census of Population, 1960: Characteristics of the Population, Arkansas, Vol. I, Part 5, Table 85, pp. 5-208 to 5-213; 1950, Vol. II, Part 5, Table 43, pp. 4-83 to 4-92; and 1940, Vol. II, Part 1, Table 23, pp. 438 to 447 (Washington: Government Printing Office).

Table III-5

Employment by Industry, 1940, 1950, and 1960

Haskell County, Oklahoma

Industry	1940	1950	1960
Agriculture, Including Forestry and Fisheries	2,448	2,026	560
Mining	87	267	132
Construction	58	166	186
Manufacturing	56	95	172
Wholesale and Retail Trade	310	421	488
Finance, Insurance, and Real Estate	30	32	42
Transportation	35	57	40
Communications and Public Utilities	22	65	61
Services	361	433	397
Government	80	102	124
Other	61	55	114
Total	3,548	3,719	2,316

SOURCE: Peach, W. N., Poole, R. W., and Tarver, J. D., *County Building Block Data for Regional Analysis: Oklahoma*, Table 8.

Table III-6

Employment by Industry, 1940, 1950, and 1960

LeFlore County, Oklahoma

Industry	1940	1950	1960
Agriculture, Including Forestry and Fisheries	4,607	2,884	1,064
Mining	385	417	219
Construction	294	585	654
Manufacturing	987	1,103	1,212
Wholesale and Retail Trade	1,011	1,269	1,457
Finance, Insurance and Real Estate	62	95	141
Transportation	398	600	394
Communications and Public Utilities	109	207	182
Services	1,326	1,420	1,527
Government	215	283	337
Other	134	184	313
Total	9,528	9,047	7,500

SOURCE: Peach, W. N., Poole, R. W., and Tarver, J. D., County Building Block Data for Regional Analysis: Oklahoma, Table 8.

Table III-7

Employment by Industry, 1940, 1950, and 1960

Muskogee County, Oklahoma

Industry	1940	1950	1960
Agriculture, Including Forestry and Fisheries	5,309	3,447	1,445
Mining	213	215	194
Construction	661	1,647	1,402
Manufacturing	1,080	2,196	2,957
Wholesale and Retail Trade	3,707	4,766	4,312
Finance, Insurance and Real Estate	519	646	796
Transportation	1,055	1,314	897
Communications and Public Utilities	383	714	605
Services	4,164	5,093	5,076
Government	791	1,171	1,294
Other	399	326	934
Total	18,281	21,535	19,912

SOURCE: Peach, W. N., Poole, R. W., and Tarver, J. D., County Building Block Data for Regional Analysis: Oklahoma, Table 8.

Table III-8

Employment by Industry, 1940, 1950, and 1960

Rogers County, Oklahoma

Industry	1940	1950	1960
Agriculture, Including Forestry and Fisheries	2,735	1,882	768
Mining	319	391	404
Construction	216	577	823
Manufacturing	139	396	957
Wholesale and Retail Trade	702	965	1,218
Finance, Insurance and Real Estate	71	105	174
Transportation	163	248	325
Communications and Public Utilities	57	122	150
Services	965	1,115	1,234
Government	165	212	233
Other	183	230	347
Total	5,715	6,243	6,633

SOURCE: Peach, W. N., Poole, R. W., and Tarver, J. D., County Building Block Data for Regional Analysis: Oklahoma, Table 8.

Table III-9

Employment by Industry 1940, 1950, and 1960

Sequoyah County, Oklahoma

Industry	1940	1950	1960
Agriculture, Including Forestry and Fisheries	3,125	2,081	602
Mining	31	38	75
Construction	140	463	279
Manufacturing	316	648	1,067
Wholesale and Retail Trade	387	566	858
Finance, Insurance, and Real Estate	22	32	25
Transportation	94	158	166
Communications and Public Utilities	20	57	72
Services	593	559	689
Government	111	145	116
Other	77	156	248
Total	4,916	4,903	4,197

SOURCE: Peach, W. N., Poole, R. W., and Tarver, J. D., County Building Block Data for Regional Analysis: Oklahoma, Table 8.

Table III-10

Employment by Industry, 1940, 1950, and 1960

Tulsa County, Oklahoma

Industry	1940	1950	1960
Agriculture, Including Forestry and Fisheries	3,407	2,489	1,558
Mining	6,184	5,712	5,848
Construction	3,968	8,710	8,310
Manufacturing	11,334	18,420	27,418
Wholesale and Retail Trade	16,231	23,962	28,514
Finance, Insurance, and Real Estate	3,703	5,014	6,725
Transportation	3,379	7,134	9,110
Communications and Public Utilities	1,726	3,223	4,277
Services	18,282	20,925	26,555
Government	1,970	2,633	4,054
Other	1,037	1,320	9,752
Total	71,221	99,542	132,121

SOURCE: Peach, W. N., Poole, R. W., and Tarver, J. D., County Building Block Data for Regional Analysis: Oklahoma, Table 8.

Table III-11

Employment by Industry, 1940, 1950, and 1960

Wagoner County, Oklahoma

Industry	1940	1950	1960
Agriculture, Including Forestry and Fisheries	3,626	2,112	862
Mining	134	73	95
Construction	92	349	445
Manufacturing	89	295	619
Wholesale and Retail Trade	471	612	944
Finance, Insurance, and Real Estate	39	74	77
Transportation	88	150	135
Communications and Public Utilities	36	59	94
Services	552	604	737
Government	105	151	158
Other	79	90	163
Total	5,311	4,569	4,329

SOURCE: Peach, W. N., Poole, R. W., and Tarver, J. D., County Building Block Data for Regional Analysis: Oklahoma, Table 8.

Table III-12

Employment by Occupation, 1940, 1950, and 1960

Sequoyah County, Oklahoma

Occupation Group	1940	1950	1960
Agricultural	3,119	2,045	582
Nonagricultural	1,753	2,703	3,355
Professional, Technical, and Kindred Workers	315	295	329
Managers, Officials, and Proprietors (Except Farm)	264	253	284
Clerical and Kindred Workers, Sales Workers	184	351	575
Craftsmen, Foremen, and Kindred Workers	196	473	450
Operatives and Kindred Workers	257	639	1,033
Private Household Workers	115	30	63
Service Workers, Except Private Household	118	195	283
Laborers, Except Farm and Mine	304	467	338
Occupations Not Reported	44	155	260
Total	4,916	4,903	4,197

SOURCE: Peach, W. N., Poole, R. W., Tarver, J. D., County Building Block Data for Regional Analysis: Oklahoma, Table 9.

Table III-13

Percentage Distribution of Employment by Occupation, By County, 1960

COUNTY	Agricultural	Professional	Managers	Clerical	Craftsmen	Operative	Private Household	Service Workers	Laborers	Occupation Not Reported	Total
Haskell	23.1	8.6	8.5	14.1	11.0	16.2	2.6	5.8	5.2	4.8	100.00
LeFlore	12.2	9.5	9.6	13.6	13.1	19.1	3.3	8.6	8.8	2.4	100.00
Muskogee	6.4	10.9	10.5	21.6	12.1	14.9	3.6	11.5	5.2	3.2	100.00
Rogers	10.9	8.4	8.1	16.7	18.3	18.2	1.2	8.4	6.0	3.8	100.00
Sequoyah	13.9	7.8	6.8	13.7	10.7	24.6	1.5	6.7	8.1	6.2	100.00
Wagoner	19.2	6.4	7.0	15.2	16.3	16.1	2.0	7.9	6.6	3.3	100.00
6-County Total	10.8	9.4	9.2	17.8	13.4	17.2	2.8	9.5	6.3	3.5	100.00
Tulsa	.9	13.7	9.9	26.7	15.0	12.9	2.7	8.7	3.3	6.3	100.00
7-County Total	3.4	12.6	9.7	24.5	14.6	14.0	2.7	8.9	4.1	5.6	100.00
State of Oklahoma	8.9	11.4	9.7	21.3	13.8	14.0	2.3	9.1	4.5	5.1	100.00
U. S.[1]	6.1	11.2	8.4	21.6	13.5	18.4	2.7	8.4	4.8	4.9	100.00

Source: Table III-12

Table III-14

Occupation Group of Employed Persons by Sex and Percent Distribution, Arkansas River Region of Arkansas, 1960

Occupation	United States	State	State, Except Arkansas River Region	Arkansas River Region	Percent Distribution: United States	Percent Distribution: State	Percent Distribution: State, Except Arkansas River Region	Percent Distribution: Arkansas River Region
Total Males	43,466,946	394,839	234,961	159,878	100.0	100.0	100.0	100.0
Professional, technical and kindred workers	4,479,358	25,161	13,053	12,108	10.3	6.4	5.6	7.6
Farmers and farm managers	2,387,584	49,662	36,294	13,368	5.5	12.6	15.5	8.4
Managers, officials, and proprietors (except farm)	4,629,842	41,527	22,705	18,822	10.7	10.5	9.7	11.8
Clerical and kindred workers	3,015,476	17,495	8,716	8,779	6.9	4.4	3.7	5.5
Sales workers	2,977,872	22,994	11,917	11,077	6.9	5.8	5.1	6.9
Craftsmen, foremen and kindred workers	8,488,777	62,479	34,246	28,233	19.5	15.8	14.6	17.7
Operatives and kindred workers	8,641,687	71,037	44,159	26,878	19.5	18.0	18.2	16.8
Private household workers	61,063	585	335	250	0.1	0.1	0.1	0.1
Service workers, except private household	2,598,669	17,169	8,948	8,221	6.0	4.4	3.8	5.1
Farm laborers and foremen	1,201,922	37,435	26,292	11,143	2.8	9.5	11.7	7.0
Laborers, except farm and mine	2,997,789	35,698	21,238	14,460	6.9	9.1	9.0	9.0
Occupation not reported	1,986,907	13,597	7,058	6,539	4.6	3.4	3.0	4.1
Total Females	21,172,301	170,652	92,973	77,679	100.0	100.0	100.0	100.0
Professional, technical and kindred workers	2,753,052	20,959	11,263	9,696	13.0	12.3	12.1	12.5
Farmers and farm managers	118,100	2,343	1,790	553	0.6	1.4	1.9	0.7
Managers, officials and proprietors (except farm)	779,701	8,717	5,076	3,641	3.7	5.1	5.5	4.7
Clerical and kindred workers	6,291,420	33,370	15,813	17,557	29.7	19.5	17.0	22.6
Sales workers	1,661,113	14,103	7,901	6,202	7.8	8.3	8.5	8.0
Craftsmen, foremen and kindred workers	252,215	1,722	873	849	1.2	1.0	0.9	1.1
Operatives and kindred workers	3,255,949	25,871	13,872	11,999	15.4	15.2	14.9	15.5
Private household workers	1,664,763	24,281	14,962	9,319	7.9	14.2	16.1	12.0
Service workers, except private household	2,846,289	27,278	14,741	12,537	13.4	16.0	15.9	16.1
Farm laborers and foremen	242,885	2,986	2,187	799	1.1	1.7	2.3	1.0
Laborers, except farm and mine	109,746	1,075	532	543	0.5	0.6	0.6	0.7
Occupation not reported	1,196,768	7,947	3,963	3,984	5.7	4.7	4.3	5.1

Source: U.S. Department of Commerce, Bureau of the Census, Census of Population, 1960: General Social and Economic Characteristics, Arkansas, PC(1)-5C, Table 57, p. 149; Characteristics of the Population, U.S. Summary, Vol. I, Part 1, Table 89, p. 1-219 (Washington: Government Printing Office); and compiled from Appendix Tables 8 through 11.

Table III-15

Occupation Group of Employed Persons by Sex and Percent Distribution, Arkansas River Region of Arkansas, West Subregion, 1960

Occupation	West Subregion						
	Total	Crawford	Franklin	Logan	Polk	Scott	Sebastian
Total Males	29,885	4,661	2,286	3,324	2,675	1,698	15,241
Professional, technical and kindred workers	1,868	182	99	251	133	101	1,102
Farmers and farm managers	2,296	391	507	441	393	281	283
Managers, officials and proprietors (except farm)	3,860	403	161	343	299	125	2,529
Clerical and kindred workers	1,761	225	103	134	118	39	1,142
Sales workers	2,254	220	93	141	156	70	1,574
Craftsmen, foremen and kindred workers	5,237	1,007	365	576	328	265	2,696
Operatives and kindred workers	5,797	1,071	419	591	491	348	2,877
Private household workers	38	12	-	-	-	-	26
Service workers, except private household	1,410	142	50	182	64	32	940
Farm laborers and foremen	1,578	378	218	265	112	103	502
Laborers, except farm and mine	2,670	403	234	236	520	297	980
Occupation not reported	1,116	227	37	164	61	37	590
	Percent Distribution						
Total Males	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Professional, technical and kindred workers	6.3	3.9	4.3	7.6	5.0	5.9	7.2
Farmers and farm managers	7.7	8.4	22.2	13.2	14.7	16.5	1.9
Managers, officials and proprietors (except farm)	12.9	8.6	7.0	10.3	11.2	7.4	16.6
Clerical and kindred workers	5.9	4.8	4.5	4.0	4.4	2.3	7.4
Sales workers	7.6	4.7	4.1	4.3	5.8	4.1	10.3
Craftsmen, foremen and kindred workers	17.5	21.6	16.0	17.3	12.3	15.6	17.7
Operatives and kindred workers	19.4	23.0	18.3	17.8	18.3	20.5	18.9
Private household workers	0.1	0.3	-	-	-	-	0.2
Service workers, except private household	4.7	3.1	2.2	5.5	2.4	1.9	6.2
Farm laborers and foremen	5.3	8.1	9.6	8.0	4.2	6.1	3.3
Laborers, except farm and mine	8.9	8.6	10.2	7.1	19.4	17.5	6.4
Occupation not reported	3.7	4.9	1.6	4.9	2.3	2.2	3.9

- continued -

Table III-15 (Continued)

Occupation Group of Employed Persons by Sex and Percent Distribution, Arkansas River Region of Arkansas, West Subregion, 1960

Occupation	West Subregion						
	Total	Crawford	Franklin	Logan	Polk	Scott	Sebastian
Total Females	13,452	1,761	638	1,380	1,275	640	7,750
Professional, technical and kindred workers	1,693	217	97	191	135	79	974
Farmers and farm managers	89	8	12	33	20	9	7
Managers, officials and proprietors (except farm)	755	73	32	83	61	27	479
Clerical and kindred workers	2,800	262	103	206	168	96	1,965
Sales workers	1,087	145	47	103	120	44	628
Craftsmen, foremen and kindred workers	213	26	15	24	16	8	124
Operatives and kindred workers	2,378	435	100	186	437	139	1,081
Private household workers	1,205	110	48	72	61	55	859
Service workers, except private household	2,199	284	123	377	159	111	1,145
Farm laborers and foremen	125	19	25	20	4	45	12
Laborers, except farm and mine	100	16	-	4	12	15	53
Occupation not reported	808	166	36	89	82	12	423
	Percent Distribution						
Total Females	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Professional, technical and kindred workers	12.6	12.3	15.2	13.8	10.6	12.3	12.5
Farmers and farm managers	0.7	0.5	1.9	2.4	1.6	1.4	0.1
Managers, officials and proprietors (except farm)	5.6	4.1	5.0	6.0	4.8	4.2	6.2
Clerical and kindred workers	20.8	14.9	16.1	14.8	13.2	15.0	25.4
Sales workers	8.1	8.2	7.4	7.4	9.4	6.9	8.1
Craftsmen, foremen and kindred workers	1.6	1.5	2.4	1.7	1.2	1.3	1.6
Operatives and kindred workers	17.7	24.7	15.7	13.4	34.3	21.7	13.9
Private household workers	9.0	6.3	7.5	5.2	4.8	8.6	11.1
Service workers, except private household	16.3	16.1	19.3	27.2	12.5	17.3	14.8
Farm laborers and foremen	0.9	1.1	3.9	1.4	0.3	7.0	0.1
Laborers, except farm and mine	0.7	0.9	-	0.3	0.9	2.4	0.7
Occupation not reported	6.0	9.4	5.6	6.4	6.4	1.9	5.5

Source: U.S. Department of Commerce, Bureau of the Census, Census of Population, 1960: General Social and Economic Characteristics, Arkansas, PC(1)-5C (Washington: Government Printing Office), Table 84, pp. 5-202 to 5-207.

Table III-16

Occupation Group of Employed Persons by Sex and Percent Distribution,
Arkansas River Region of Arkansas, Central Subregion No. 1, 1960

Occupation	Total	Conway	Johnson	Perry	Pope	Yell
	Central Subregion No. 1					
Total Males	14,228	3,100	2,543	1,051	4,814	2,720
Professional, technical and kindred workers	861	195	192	58	290	126
Farmers and farm managers	1,989	480	433	168	461	447
Managers, officials and proprietors (except farm)	1,391	294	224	41	590	242
Clerical and kindred workers	548	104	100	32	200	112
Sales workers	758	209	90	37	317	105
Craftsmen, foremen and kindred workers	2,019	446	318	157	767	331
Operatives and kindred workers	2,434	544	355	156	858	521
Private household workers	-	-	-	-	-	-
Service workers, except private household	492	110	86	16	226	54
Farm laborers and foremen	1,380	346	233	96	422	283
Laborers, except farm and mine	1,833	267	394	170	607	395
Occupation not reported	523	105	118	120	76	104
	Percent Distribution					
Total Males	100.0	100.0	100.0	100.0	100.0	100.0
Professional, technical and kindred workers	6.0	6.3	7.6	5.5	6.0	4.6
Farmers and farm managers	14.0	15.5	17.0	16.0	9.6	16.4
Managers, officials and proprietors (except farm)	9.8	9.5	8.8	3.9	12.3	8.9
Clerical and kindred workers	3.8	3.4	3.9	3.1	4.2	4.1
Sales workers	5.3	6.7	3.5	3.5	6.6	3.9
Craftsmen, foremen and kindred workers	14.2	14.4	12.5	15.0	15.9	12.2
Operatives and kindred workers	17.1	17.5	13.9	14.8	17.8	19.2
Private household workers	-	-	-	-	-	-
Service workers, except private household	3.5	3.5	3.4	1.5	4.7	2.0
Farm laborers and foremen	9.7	11.2	9.2	9.1	8.7	10.4
Laborers, except farm and mine	12.9	8.6	15.5	16.2	12.6	14.5
Occupation not reported	3.7	3.4	4.7	11.4	1.6	3.8

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Table III-16 (Continued)

Occupation Group of Employed Persons by Sex and Percent Distribution, Arkansas River Region of Arkansas, Central Subregion No. 1, 1960

Occupation	Central Subregion No. 1					
	Total	Conway	Johnson	Perry	Pope	Yell
Total Females	6,003	1,445	977	310	2,254	1,017
Professional, technical and kindred workers	778	198	148	27	304	101
Farmers and farm managers	111	20	24	-	24	43
Managers, officials and proprietors (except farm)	300	52	54	23	109	62
Clerical and kindred workers	995	204	173	65	431	122
Sales workers	423	100	71	9	166	77
Craftsmen, foremen and kindred workers	61	25	-	4	27	5
Operatives and kindred workers	1,334	361	145	32	562	234
Private household workers	540	141	74	11	216	98
Service workers, except private household	873	184	163	72	310	144
Farm laborers and foremen	175	58	44	8	45	20
Laborers, except farm and mine	61	16	12	5	20	8
Occupation not reported	352	86	69	54	40	103
	Percent Distribution					
Total Females	100.0	100.0	100.0	100.0	100.0	100.0
Professional, technical and kindred workers	13.0	13.7	15.1	8.7	13.5	9.9
Farmers and farm managers	1.9	1.4	2.5	-	1.1	4.2
Managers, officials and proprietors (except farm)	5.0	3.6	5.5	7.4	4.8	6.1
Clerical and kindred workers	16.6	14.1	17.7	21.0	19.1	12.0
Sales workers	7.0	6.9	7.3	2.9	7.4	7.6
Craftsmen, foremen and kindred workers	1.0	1.7	-	1.3	1.2	0.5
Operatives and kindred workers	22.2	25.0	14.8	10.3	24.9	23.0
Private household workers	9.0	9.8	7.6	3.6	9.6	9.6
Service workers, except private household	14.5	12.7	16.7	23.2	13.7	14.2
Farm laborers and foremen	2.9	4.0	4.5	2.6	2.0	2.0
Laborers, except farm and mine	1.0	1.1	1.2	1.6	0.9	0.8
Occupation not reported	5.9	6.0	7.1	17.4	1.8	10.1

Source: U.S. Department of Commerce, Bureau of the Census, Census of Population, 1960: General Social and Economic Characteristics, Arkansas, PC(1)-5C (Washington: Government Printing Office), Table 84, pp. 5-202 to 5-207.

Table III-17

Occupation Group of Employed Persons by Sex and Percent Distribution, Arkansas River Region of Arkansas, Central Subregion No. 2, 1960

Occupation	Total	Cleburne	Faulkner	Lonoke	Prairie	Pulaski	Saline	Van Buren	White
	Central Subregion No. 2								
Total Males	84,681	2,020	5,528	5,530	2,506	54,373	5,900	1,581	7,243
Professional, technical and kindred workers	7,421	161	426	271	77	5,411	460	106	509
Farmers and farm managers	5,970	460	756	1,230	887	708	156	486	1,287
Managers, officials and proprietors (except farm)	10,648	184	644	434	194	7,854	514	133	691
Clerical and kindred workers	5,224	33	245	149	53	4,247	212	50	235
Sales workers	6,450	95	337	223	72	5,022	254	77	370
Craftsmen, foremen and kindred workers	15,949	400	1,066	751	301	10,610	1,408	172	1,241
Operatives and kindred workers	12,452	260	951	839	214	7,394	1,550	185	1,059
Private household workers	147	-	9	-	-	115	19	-	4
Service workers, except private household	5;123	36	251	117	33	4,125	298	29	234
Farm laborers and foremen	4,717	133	389	1,005	447	1,846	148	93	656
Laborers, except farm and mine	6,651	198	392	306	190	3,922	678	190	775
Occupation not reported	3,929	60	62	205	38	3,119	203	60	182
	Percent Distribution								
Total Males	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Professional, technical and kindred workers	8.8	8.0	7.7	4.9	3.1	10.0	7.8	6.7	7.0
Farmers and farm managers	7.0	22.8	13.7	22.2	35.4	1.3	2.6	30.7	17.8
Managers, officials and proprietors (except farm)	12.6	9.1	11.7	7.9	7.8	14.5	8.7	8.4	9.5
Clerical and kindred workers	6.2	1.6	4.4	2.7	2.1	7.8	3.6	3.2	3.3
Sales workers	7.6	4.7	6.1	4.0	2.9	9.2	4.3	4.9	5.1
Craftsmen, foremen and kindred workers	18.8	19.8	19.2	13.6	12.0	19.5	23.9	10.9	17.1
Operatives and kindred workers	14.7	12.8	17.2	15.2	8.5	13.6	26.3	11.7	14.6
Private household workers	0.2	-	0.2	-	-	0.2	0.3	-	0.1
Service workers, except private household	6.0	1.8	4.5	2.1	1.3	7.6	5.1	1.8	3.2
Farm laborers and foremen	5.6	6.6	7.1	18.2	17.8	3.4	2.5	5.9	9.1
Laborers, except farm and mine	7.9	9.8	7.1	5.5	7.6	7.2	11.5	12.0	10.7
Occupation not reported	4.6	3.0	1.1	3.7	1.5	5.7	3.4	3.8	2.5

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Table III-17 (Continued)

Occupation Group of Employed Persons by Sex and Percent Distribution, Arkansas River Region of Arkansas, Central Subregion No. 2, 1960

	Central Subregion No. 2								
Occupation	Total	Cleburne	Faulkner	Lonoke	Prairie	Pulaski	Saline	Van Buren	White
Total Females	45,204	488	2,747	1,675	559	33,848	2,260	437	3,190
Professional, technical and kindred workers	5,572	62	340	218	46	4,190	287	26	403
Farmers and farm managers	289	67	62	31	7	46	-	22	54
Managers, officials and proprietors (except farm)	1,928	19	78	77	31	1,537	61	30	95
Clerical and kindred workers	11,235	84	568	249	110	9,088	533	36	567
Sales workers	3,626	79	230	195	62	2,479	216	87	278
Craftsmen, foremen and kindred workers	468	-	28	4	4	368	12	-	52
Operatives and kindred workers	6,751	51	521	309	63	4,797	282	83	645
Private household workers	4,805	35	290	272	77	3,743	143	12	233
Service workers, except private household	7,550	69	473	197	107	5,488	556	80	580
Farm laborers and foremen	371	7	101	33	13	82	-	31	104
Laborers, except farm and mine	309	-	20	3	29	205	8	-	44
Occupation not reported	2,300	15	36	87	10	1,825	162	30	135
	Percent Distribution								
Total Females	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Professional, technical and kindred workers	12.3	12.7	12.4	13.0	8.2	12.4	12.7	6.0	12.6
Farmers and farm managers	0.7	13.7	2.2	1.8	1.3	0.1	-	5.0	1.7
Managers, officials and proprietors (except farm)	4.3	3.9	2.8	4.6	5.5	4.5	2.7	6.9	3.0
Clerical and kindred workers	24.9	17.2	20.7	14.8	19.7	26.9	23.6	8.2	17.8
Sales workers	8.0	16.2	8.4	11.6	11.1	7.3	9.6	19.9	8.7
Craftsmen, foremen and kindred workers	1.0	-	1.0	0.2	0.7	1.1	0.5	-	1.6
Operatives and kindred workers	14.9	10.5	19.0	18.4	11.3	14.2	12.5	19.0	20.2
Private household workers	10.6	7.2	10.6	16.2	13.8	11.1	6.3	2.7	7.3
Service workers, except private household	16.7	14.1	17.2	11.8	19.1	16.2	24.6	18.3	18.2
Farm laborers and foremen	0.8	1.4	3.7	2.0	2.3	0.2	-	7.1	3.3
Laborers, except farm and mine	0.7	-	0.7	0.2	5.2	0.6	0.3	-	1.4
Occupation not reported	5.1	3.1	1.3	5.4	1.8	5.4	7.2	6.9	4.2

Source: U.S. Department of Commerce, Bureau of the Census, Census of Population, 1960: General Social and Economic Characteristics, Arkansas, PC(1)-5C (Washington: Government Printing Office), Table 84, pp. 5-202 to 5-207.

Table III-18

Occupation Group of Employed Persons by Sex and Percent Distribution, Arkansas River Region of Arkansas, Central Subregion No. 3, 1960

Occupation	Central Subregion No. 3						
	Total	Arkansas	Cleveland	Dallas	Grant	Jefferson	Lincoln
Total Males	31,084	5,951	1,506	2,254	1,872	17,113	2,388
Professional, technical and kindred workers	1,958	318	78	151	114	1,214	83
Farmers and farm managers	3,113	1,128	261	114	94	1,010	506
Managers, officials, and proprietors (except farm)	2,923	588	83	211	201	1,690	150
Clerical and kindred workers	1,246	205	46	60	57	838	40
Sales workers	1,615	278	49	67	46	1,120	55
Craftsmen, foremen and kindred workers	5,028	805	252	312	374	3,037	248
Operatives and kindred workers	6,195	669	313	583	414	3,671	545
Private household workers	65	17	7	-	-	29	12
Service workers, except private household	1,196	181	39	46	61	799	70
Farm laborers and foremen	3,468	1,175	93	128	94	1,486	492
Laborers, except farm and mine	3,306	439	268	537	360	1,566	136
Occupation not reported	971	148	17	45	57	653	51
	Percent Distribution						
Total Males	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Professional, technical and kindred workers	6.3	5.3	5.2	6.7	6.1	7.1	3.5
Farmers and farm managers	10.0	19.0	17.3	5.1	5.0	5.9	21.2
Managers, officials and proprietors (except farm)	9.4	9.9	5.5	9.4	10.8	9.9	6.3
Clerical and kindred workers	4.0	3.5	3.1	2.7	3.0	4.9	1.7
Sales workers	5.2	4.7	3.2	3.0	2.5	6.5	2.3
Craftsmen, foremen and kindred workers	16.2	13.5	16.7	13.8	20.0	17.7	10.4
Operatives and kindred workers	19.9	11.2	20.8	25.8	22.1	21.5	22.8
Private household workers	0.2	0.3	0.5	-	-	0.2	0.5
Service workers, except private household	3.9	3.0	2.6	2.0	3.3	4.7	2.9
Farm laborers and foremen	11.2	19.7	6.2	5.7	5.0	8.7	20.6
Laborers, except farm and mine	10.6	7.4	17.8	23.8	19.2	9.1	5.7
Occupation not reported	3.1	2.5	1.1	2.0	3.0	3.8	2.1

- continued -

Table III-18 (Continued)

Occupation Group of Employed Persons by Sex and Percent Distribution, Arkansas River Region of Arkansas, Central Subregion No. 3, 1960

Occupation	Central Subregion No. 3						
	Total	Arkansas	Cleveland	Dallas	Grant	Jefferson	Lincoln
Total Females	13,020	2,446	417	872	445	7,914	926
Professional, technical and kindred workers	1,653	243	60	135	64	1,051	100
Farmers and farm managers	64	13	8	8	-	22	13
Managers, officials and proprietors (except farm)	658	127	34	39	16	396	46
Clerical and kindred workers	2,527	474	33	174	85	1,693	68
Sales workers	1,066	220	40	90	51	632	33
Craftsmen, foremen and kindred workers	107	21	9	-	4	69	4
Operatives and kindred workers	1,536	307	73	38	53	730	335
Private household workers	2,769	548	88	188	33	1,785	127
Service workers, except private household	1,915	381	56	154	98	1,156	70
Farm laborers and foremen	128	12	-	7	5	31	73
Laborers, except farm and mine	73	12	-	18	-	23	20
Occupation not reported	524	88	16	21	36	326	37
	Percent Distribution						
Total Females	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Professional, technical and kindred workers	12.7	9.9	14.4	15.5	14.4	13.3	10.8
Farmers and farm managers	0.5	0.5	1.9	0.9	-	0.3	1.4
Managers, officials and proprietors (except farm)	5.0	5.2	8.2	4.5	3.6	5.0	5.0
Clerical and kindred workers	19.4	19.4	7.9	19.9	19.1	21.4	7.3
Sales workers	8.2	9.0	9.6	10.3	11.5	8.0	3.6
Craftsmen, foremen and kindred workers	0.9	0.8	2.2	-	0.9	0.9	0.4
Operatives and kindred workers	11.8	12.6	17.5	4.3	11.9	9.2	36.2
Private household workers	21.3	22.4	21.1	21.6	7.4	22.5	13.7
Service workers, except private household	14.7	15.6	13.4	17.7	22.0	14.6	7.5
Farm laborers and foremen	1.0	0.5	-	0.8	1.1	0.4	7.9
Laborers, except farm and mine	0.5	0.5	-	2.1	-	0.3	2.2
Occupation not reported	4.0	3.6	3.8	2.4	8.1	4.1	4.0

Source: U.S. Department of Commerce, Bureau of the Census, Census of Population, 1960: General Social and Economic Characteristics, Arkansas, PC(1)-5C (Washington: Government Printing Office), Table 84, pp. 5-202 to 5-207.

Table III-19

United States Median Annual Money Income
For Males, by Occupation, 1960

Occupation	Median Annual Income	Computed Income Index
Agricultural[1]	$1,635	100.00
Nonagricultural		
Professional	6,692	404.40
Managers	6,519	398.71
Clerical[2]	5,000	305.81
Craftsmen	5,582	341.41
Operatives	4,477	273.82
Private Household[3]	---	---
Service Workers	3,412	208.68
Laborers	2,868	175.41
Occupations Not Reported	---	---

[1]Includes farmers, farm managers, and farm laborers.

[2]Includes sales workers.

[3]Mostly female workers.

Source: Statistical Abstract of the United States, 1966, Table 486.

Table III-20

Labor Force Participation Rates, 1960
(Percentages)

	Male	Percentage points of difference from U.S.	Female	Percentage points of difference from U.S.
U.S.	78.0		34.5	
State of Oklahoma	73.5	- 4.5	30.1	- 4.4
Tulsa Co.	81.1	+ 3.1	36.4	+ 1.9
Haskell Co.	59.2	-18.8	17.3	-17.2
LeFlore Co.	58.2	-19.8	21.2	-12.3
Muskogee Co.	66.7	-11.3	30.8	- 3.7
Rogers Co.	71.0	- 7.0	24.7	- 9.8
Sequoyah Co.	55.9	-22.1	18.6	-15.9
Wagoner Co.	65.1	-12.9	19.8	-14.7
State of Arkansas	70.3	- 7.7	28.5	- 6.0
Arkansas River Region	70.2	- 7.8	31.2	- 3.3
Subregion West	70.2	- 7.8	29.0	- 5.5
Subregion Central No. 1	64.9	-13.1	26.2	- 8.3
Subregion Central No. 2	72.3	- 5.7	34.0	- .5
Subregion Central No. 3	68.6	- 9.4	27.9	- 6.6

Sources: U.S.--U.S. Census; Oklahoma--The Arkansas River Basin in Oklahoma, Dr. Jack L. Robinson, University of Oklahoma, 1967, Table 30; Arkansas--Arkansas River Region Report, Arkansas Planning Commission, 1966, Vol. I, Section A, Appendix Table 4.

Table III-21

Median Family Income, 1960, Arkansas River Region Counties

	Median Family Income ($)	As Percent of U.S. Median
United States	5660	100.0
State of Oklahoma	4620	81.6
7-County Region		
Haskell	2247	39.7
LeFlore	2648	46.8
Muskogee	3933	69.5
Rogers	3855	68.1
Sequoyah	2492	44.0
Tulsa	5995	105.9
Wagoner	3271	57.8
10-County Region		
Adair	1919	33.9
Cherokee	2657	46.9
Creek	4265	75.3
Latimer	2618	46.2
Mayes	3468	61.0
McIntosh	2066	36.5
Okmulgee	4048	71.5
Osage	4918	86.8
Pawnee	3580	63.2
Washington	6279	110.9
State of Arkansas	N.A.	N.A.
West Subregion		
Crawford	3122	55.1
Franklin	2611	46.1
Logan	2376	41.9
Polk	2694	47.5
Scott	2168	38.3
Sebastian	4241	74.9
Central Subregion No. 1		
Conway	2751	48.6
Johnson	2484	43.8
Perry	2217	39.1
Pope	3046	53.8
Yell	2600	45.9

Table III-27 (Continued)

Median Family Income, 1960, Arkansas River Region Counties

	Median Family Income ($)	As Percent of U.S. Median
Central Subregion No. 2		
Cleburne	2137	37.7
Faulkner	2968	52.4
Lonoke	2708	47.8
Prairie	2853	50.4
Pulaski	4935	87.1
Saline	4483	79.2
Van Buren	1968	34.7
White	2893	51.1
Central Subregion No. 3		
Arkansas	3348	59.1
Cleveland	2363	41.7
Dallas	2809	49.6
Grant	2985	52.7
Jefferson	3671	64.8
Lincoln	1911	33.7

Source: U.S. Census, 1960, Vol. I, Table 86.

Table III-22

Estimated Per Capita Income

	1950	1960	1963	Percent Change 1950-60	Percent Change 1950-63	Percent Change 1960-63
United States	$1,491	$2,217	$2,449	49	64	10
State of Arkansas	815	1,340	1,597	64	96	19
Arkansas River Region	921	1,522	1,759	65	91	16
West Subregion	925	1,446	1,725	56	86	19
Sebastian County-Fort Smith	1,328	1,823	2,111	37	59	16
Remainder of Subregion	600	1,069	1,270	78	112	19
Central Subregion No. 1	611	1,133	1,351	85	121	19
Pope County-Russellville	678	1,261	1,491	86	120	18
Remainder of Subregion	582	1,072	1,281	84	120	19
Central Subregion No. 2	1,044	1,690	1,915	62	83	13
Pulaski County-Little Rock	1,326	1,987	2,217	50	67	12
Remainder of Subregion	673	1,164	1,358	73	102	17
Central Subregion No. 3	791	1,327	1,549	68	96	17
Jefferson County-Pine Bluff	867	1,431	1,625	65	87	14
Remainder of Subregion	710	1,193	1,446	68	104	12

Source: Bureau of Business and Economic Research, College of Business Administration, University of Arkansas. Derived primarily from National and State income statistics published by the United States Department of Commerce.

Table III-23

Families with Income Below $3000, 1960

Arkansas River Region Counties

	No. of families with income below $3000	Percent of total families
United States		21.4
State of Oklahoma	189,941	31.0
7-County Region	34,651	26.2
6-County Region (without Tulsa)	18,794	46.6
Haskell	1,593	65.1
LeFlore	4,442	56.5
Muskogee	6,094	38.2
Rogers	2,121	38.6
Sequoyah	2,634	58.1
Wagoner	1,910	46.6
Tulsa	15,857	17.2
10-County Region	23,414	39.7
9-County Region (without Washington)	21,691	45.5
Adair	2,335	69.3
Cherokee	2,427	55.8
Creek	3,709	35.0
Latimer	1,059	56.8
Mayes	2,361	44.4
McIntosh	2,061	63.9
Okmulgee	3,750	38.3
Osage	2,406	27.6
Pawnee	1,283	42.1
Washington	1,723	15.1
17-County Region	58,065	30.2
State of Arkansas	N.A.	N.A.

Table III-23 (Continued)

Families with Income Below $3000, 1960

Arkansas River Region Counties

	No. of families with income below $3000	Percent of tot families
West Subregion		
Crawford	2,783	48.3
Franklin	1,600	56.8
Logan	2,571	61.9
Polk	1,875	55.8
Scott	1,347	66.2
Sebastian	5,929	32.6
Central Subregion No. 1		
Conway	2,095	53.0
Johnson	2,065	60.3
Perry	811	65.9
Pope	2,787	49.2
Yell	1,896	58.1
Central Subregion No. 2		
Cleburne	1,662	64.2
Faulkner	3,096	50.5
Lonoke	3,283	54.3
Prairie	1,429	52.3
Pulaski	15,976	25.9
Saline	2,151	31.8
Van Buren	1,394	68.5
White	4,533	51.8
Central Subregion No. 3		
Arkansas	2,693	45.1
Cleveland	1,094	61.5
Dallas	1,412	54.3
Grant	1,138	50.2
Jefferson	8,295	42.8
Lincoln	1,883	64.4

Source: U.S. Census, 1960, Vol. I, Table 86.

Table III-24

Percentage Breakdown of Personal Income by Major Component, 1962

COUNTY	Total Personal Income	Wages, Salaries, And Other Labor Income	Proprietor Income	Property Income	Transfer Payments	Less Personal Contributions For Social Insurance
Haskell	100.00	37.3	23.7	8.6	31.8	1.4
LeFlore	100.00	49.7	14.5	10.8	26.9	1.9
Muskogee	100.00	64.2	13.1	11.1	14.1	2.5
Rogers	100.00	54.8	17.3	11.2	18.8	2.1
Sequoyah	100.00	39.3	17.2	10.3	34.7	1.5
Wagoner	100.00	35.6	25.4	12.5	27.9	1.4
6-County Total	100.00	56.4	15.3	11.0	19.5	2.2
Tulsa	100.00	67.3	15.2	14.3	5.8	2.6
7-County Total	100.00	65.7	15.2	13.8	7.8	2.6
State of Oklahoma	100.00	64.3	15.7	13.0	9.5	2.5
United States	100.00	69.8	11.3	13.3	7.9	2.3

Source: Peach, W. N., Poole, R. W., and Tarver, J. D., County Building Block Data for Regional Analysis: Oklahoma, Table 1.

Table III-25

Comparison of Income Payment Sources, 1963, Percentage of Total Payments

	United States	State of Arkansas	Arkansas River Region	Subregions			
				West	Central No. 1	Central No. 2	Central No. 3
Total Payments	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Participation Income	80.9	81.1	82.1	79.9	76.6	83.3	82.7
Farming	3.5	14.6	8.1	4.4	16.8	5.1	18.7
Mining	0.9	1.0	0.7	0.8	1.0	0.8	0.2
Contract Construction	5.0	5.6	7.1	6.9	6.5	7.5	6.0
Manufacturing	23.0	16.9	17.1	21.7	17.3	15.2	18.5
Trade	15.0	13.3	14.7	14.8	10.0	16.3	11.3
Finance, Ins., & Real Estate	4.1	3.1	3.9	2.4	1.6	5.3	2.0
Transp., Comm., & Public Util.	5.9	6.1	7.3	5.7	3.9	7.8	8.5
Other Services	10.9	8.4	9.1	8.0	6.7	10.8	5.8
Government[1]	12.5	12.2	14.1	15.1	12.8	14.6	11.6
Property Income	13.7	10.4	10.8	11.5	9.8	10.9	10.4
Transfer Payments	7.9	10.9	9.5	10.9	15.9	8.3	9.5
Less: Soc. Ins. Contributions	(2.6)	(2.4)	(2.4)	(2.4)	(2.3)	(2.5)	(2.5)

[1]Includes Federal Military Pay and Allowances.

Source: Bureau of Business and Economic Research, College of Business Administration, University of Arkansas. Derived primarily from National and State income statistics published by the United States Department of Commerce.

Table III-26

Population 1960 and Changes 1950-60

Arkansas River Region Counties

	1960 Population	Percent Change 1950-1960	Net Migration 1950-1960
State of Arkansas	1,786,272	- 6.5	-22.7
Arkansas River Region	724,618	+ 1.4	-14.5
West Subregion	133,451	- 7.2	-22.0
Crawford	21,318	- 6.2	-20.5
Franklin	10,213	-17.4	-27.1
Logan	15,957	-21.2	-28.8
Polk	11,981	-15.5	-22.8
Scott	7,297	-27.4	-34.0
Sebastian*	66,685	+ 3.9	-17.4
Central Subregion No. 1	65,895	-15.1	-24.0
Conway	15,430	-14.9	-25.6
Johnson	12,421	-23.0	-29.6
Perry	4,927	-17.6	-26.7
Pope*	21,177	- 9.1	-19.2
Yell	11,940	-15.1	-22.3
Central Subregion No. 2	380,337	+ 9.9	- 7.0
Cleburne	9,059	-21.1	-27.6
Faulkner	24,303	- 3.9	-15.8
Lonoke	24,551	-10.0	-27.5
Prairie	10,515	-23.6	-36.7
Pulaski*	242,980	+23.5	+ 3.7
Saline	28,956	+21.6	+ 6.1
Van Buren	7,228	-25.4	-32.9
White	32,745	-13.9	-25.8
Central Subregion No. 3	144,935	- 1.5	-20.0
Arkansas	23,355	- 1.3	-21.0
Cleveland	6,944	-22.5	-32.3
Dallas	10,522	-15.3	-28.5
Grant	8,294	- 8.1	-19.0
Jefferson*	81,373	+ 7.0	-13.7
Lincoln	14,447	-15.4	-35.1

Table III-26 (Continued)

Population 1960 and Changes 1950-60

Arkansas River Region Counties

	1960 Population	Percent Change 1950-1960	Net Migration 1950-1960
State of Oklahoma	2,328,284	+ 4.3	- 8.6
7-County Region	500,419	+18.6	N.A.
Haskell	9,121	-31.5	-37.2
LeFlore	29,106	-17.5	-25.0
Muskogee	61,866	- 5.7	-14.3
Rogers	20,614	+ 5.5	- 6.3
Sequoyah	18,001	- 9.0	-19.2
Tulsa*	346,038	+37.5	+13.9
Wagoner	15,673	- 6.4	-15.5

*Urban centers

Source: U.S. Census, 1960.

Table III-27

Net Migration Rates of "Prime" Age Groups, by County, 1950-1960

County	20 - 24		25 - 29		30 - 34		35 - 39		40 - 44		45 - 49	
	Total	Male	Total	Male	Total	Male	Total	Male	Total	Male	Total	Male
Haskell	-77.6	-78.6	-73.9	-76.6	-51.3	-57.4	-33.9	-43.2	-30.3	-28.0	-23.4	-24.7
LeFlore	-67.4	-68.8	-62.8	-65.3	-38.5	-43.1	-26.1	-29.6	-18.4	-19.8	-14.4	-18.0
Muskogee	-45.7	-49.5	-42.0	-44.5	-20.7	-16.9	-15.1	-15.4	-15.2	-15.2	- 9.8	-11.0
Rogers	-41.8	-45.5	-29.6	-35.0	+ 3.8	+ 1.7	+11.1	+15.0	+ 6.7	+ 9.3	- 4.0	- 3.2
Sequoyah	-62.5	-62.9	-55.4	-59.7	-21.6	-26.4	-17.1	-19.4	-12.3	-11.7	-10.6	-10.6
Tulsa	+25.2	+ 8.1	+44.8	+46.9	+29.6	+38.5	+14.7	+16.7	+12.3	+14.0	+ 9.9	+12.8
Wagoner	-59.8	-57.6	-53.8	-56.5	-15.2	-20.6	- 9.9	-14.3	-12.7	-16.4	- 6.1	- 2.8
State of Oklahoma	-20.0	-18.2	-23.3	-24.8	-15.0	-16.5	-11.6	-12.6	- 8.5	- 8.8	- 6.5	- 6.7

Net migration rates are expressed as percentages of the 1960 survivors of the 1950 population and the births during the decade 1950-1960.

(-) means out-migration.

Source: Net Migration of the Population, 1950-1960 By Age, Sex, and Color, Volume I, Part 5, Table 1.

Table III-28

Percent Distribution of Population by Age[a]

Arkansas River Region Counties, 1960

	0-19	20-39	40-59	60+
United States	38.5	25.7	22.6	13.2
Oklahoma State	37.9	24.6	22.7	14.9
7-County Region	38.7	25.7	22.4	13.2
6-County Region (minus Tulsa)	38.9	20.2	23.1	17.8
Haskell	38.7	17.4	25.4	18.5
LeFlore	38.4	18.1	23.5	20.0
Muskogee	37.9	21.2	23.1	17.8
Rogers	38.3	22.8	22.9	16.0
Sequoyah	42.3	19.6	21.9	16.2
Wagoner	40.9	19.5	22.2	17.3
Tulsa	38.6	28.1	22.1	11.2
State of Arkansas	N.A.	N.A.	N.A.	N.A.
West Subregion				
Crawford	38.5	20.7	23.4	17.1
Franklin	36.1	18.6	24.0	20.4
Logan	33.6	17.7	26.9	21.7
Polk	34.8	17.4	25.3	22.3
Scott	64.0	19.2	25.7	19.5
Sebastian	37.8	23.2	23.8	15.0
Central Subregion No. 1				
Conway	40.6	19.5	23.1	16.5
Johnson	35.4	18.7	24.8	20.9
Perry	38.7	17.9	23.1	20.1
Pope	37.6	22.9	22.8	16.6
Yell	35.1	18.7	26.9	19.1
Central Subregion No. 2				
Faulkner	36.1	20.8	25.4	17.5
Lonoke	43.3	19.9	21.8	14.8
Prairie	41.2	19.7	23.5	15.7
Pulaski	30.8	27.0	22.3	12.3
Saline	35.3	24.3	25.4	14.4
Van Buren	35.2	17.8	21.9	20.7
White	37.8	21.8	23.6	16.7

Table III-28 (Continued)

Percent Distribution of Population by Age[a]

Arkansas River Region Counties, 1960

	0-19	20-39	40-59	60+
Central Subregion No. 3				
Arkansas	41.6	21.9	22.2	14.0
Cleveland	39.7	18.2	24.6	17.2
Dallas	40.5	18.0	23.4	17.9
Grant	38.0	19.9	24.7	17.2
Jefferson	43.5	23.2	20.8	12.4
Lincoln	41.8	24.5	20.7	12.7

[a]Figures do not total 100 due to rounding

Source: 1960 Census, Table 27.

Table III-29

Urbanization in Arkansas River Region Counties 1950-1960

	1960 Density[a]	1960 urban pop. as % of total	Percent change total urban pop. 1950-1960	Percent change total rural pop. 1950-1960
State of Arkansas	34.0	42.8	+21.4	-20.2
West Subregion				
Crawford	35.7	31.8	+ 5.8	-10.9
Franklin	16.6	0.0	---	-17.4
Logan	22.0	35.7	+52.7	-37.9
Polk	13.9	36.6	- 1.3	-22.0
Scott	8.1	0.0	---	-27.4
Sebastian	126.3	79.5	+10.5	-15.8
Central Subregion No. 1				
Conway	27.6	38.9	+ 9.4	-25.5
Johnson	18.4	31.6	- 9.8	-27.9
Perry	8.9	0.0	---	-16.6
Pope	26.0	42.1	+ 9.2	-19.0
Yell	12.8	0.0	---	-15.1
Central Subregion No. 2				
Cleburne	15.2	0.0	---	-21.1
Faulkner	37.6	40.3	+13.7	-13.0
Lonoke	30.7	11.7	---	-20.5
Prairie	15.6	---	---	-23.6
Pulaski	316.8	82.1	+29.8	+ 1.0
Saline	39.9	35.9	+65.7	+ 5.8
Van Buren	10.1	---	---	-25.4
White	31.4	22.2	+20.7	-20.4
Central Subregion No. 3				
Arkansas	22.6	54.3	+25.3	-21.2
Cleveland	11.6	---	---	-22.5
Dallas	15.7	37.0	+ 3.6	-23.4
Grant	13.1	---	---	- 8.1
Jefferson	91.4	57.4	+25.7	-10.9
Lincoln	25.6	---	---	-15.4

Table III-29 (Continued)

Urbanization in Arkansas River Region Counties 1950-1960

	1960 Density[a]	1960 urban pop. as % of total	Percent change total urban pop. 1950-1960	Percent change total rural pop. 1950-1960
State of Oklahoma	33.8	62.9	+28.5	-21.1
7-County Region	31.0			
Haskell	14.9	---	---	-31.5
LeFlore	18.6	21.6	- 2.7	-20.8
Muskogee	75.4	61.5	+ 2.1	-15.8
Rogers	28.9	32.2	+20.8	- 0.4
Sequoyah	25.8	18.6	+16.2	-13.3
Tulsa	605.0	88.9	+48.5	-13.8
Wagoner	27.8	28.5	+ 1.7	- 9.2

[a]Persons per square mile. U.S. figure is 50.5 for 1960.

Source: U.S. Census, 1960. Table 6.

Table III-30

Percent Distribution 1960 Population by Race,

Arkansas River Region Counties

	White	Non-white
United States	88.57	11.43
State of Arkansas	75.6	24.4
River Region, Arkansas	81.9	18.1
West Subregion	95.7	4.3
Crawford	97.4	2.6
Franklin	98.8	1.2
Logan	97.9	2.1
Polk	99.9	0.1
Scott	99.9	0.1
Sebastian	93.0	7.0
Central Subregion No. 1	92.5	7.5
Conway	77.8	22.2
Johnson	97.9	2.1
Perry	96.8	3.2
Pope	96.8	3.2
Yell	96.4	3.6
Central Subregion No. 2	82.7	17.3
Cleburne	100.0	*
Faulkner	89.3	10.7
Lonoke	76.1	23.9
Prairie	81.5	18.5
Pulaski	78.5	21.5
Saline	93.6	6.4
Van Buren	98.7	1.3
White	96.1	3.9
Central Subregion No. 3	62.3	37.7
Arkansas	75.3	24.7
Cleveland	75.4	24.6
Dallas	60.2	39.8
Grant	93.1	6.9
Jefferson	56.4	43.6
Lincoln	51.4	48.6
State of Oklahoma	90.5	9.5

Table III-30 (Continued)

Percent Distribution 1960 Population by Race,

Arkansas River Region Counties

	White	Non-white
7-County Region	89.16	11.84
Haskell	95.14	4.86
LeFlore	93.20	6.80
Muskogee	77.71	22.29
Rogers	95.12	4.88
Sequoyah	88.65	11.35
Tulsa	90.79	9.21
Wagoner	81.24	18.76

*Less than 0.1%--in fact, 1 person

Source: 1960 Census, Table 27.

Table III-31

Educational Levels Attained in Arkansas River Region, 1960 by County

	Percent of Persons 25 years and Older Completing 8 or Less Years of School, 1959	Median School Years Completed
Oklahoma		
Haskell	68.7	8.2
LeFlore	64.8	8.3
Muskogee	45.5	9.7
Rogers	50.3	9.0
Sequoyah	67.8	8.2
Tulsa	28.8	12.1
Wagoner	58.8	8.6
Arkansas		
West Subregion		
Crawford	57.7	8.8
Franklin	58.9	8.8
Logan	58.1	8.8
Polk	59.2	8.8
Scott	66.1	8.6
Sebastian	39.8	10.7
Central Subregion No. 1		
Conway	54.6	8.7
Johnson	59.2	8.8
Perry	62.6	8.6
Pope	54.0	8.9
Yell	57.0	8.8
Central Subregion No. 2		
Cleburne	64.0	8.4
Faulkner	46.3	9.2
Lonoke	58.8	8.6
Prairie	62.3	8.6
Pulaski	32.9	11.5
Saline	53.8	9.0
Van Buren	64.2	8.6
White	54.1	9.0

Table III-31 (Continued)

Educational Levels Attained in Arkansas River Region,

1960 by County

	Percent of Persons 25 years and Older Completing 8 or Less Years of School, 1959	Median School Years Completed
Central Subregion No. 3		
Arkansas	54.1	8.6
Cleveland	55.3	9.0
Dallas	52.5	9.1
Grant	54.4	9.1
Jefferson	48.9	9.4
Lincoln	65.1	8.1
United States	39.7	10.6

Source: 1960 Census, Table 83.

Table III-32

Average Annual Precipitation, by County
(In Inches)

County	Average
Haskell[1]	42.6
LeFlore[1]	44.6
Muskogee[2]	40.0
Rogers[2]	38.4
Sequoyah[1]	42.8
Wagoner[2]	43.8
Tulsa[2]	37.7
State of Oklahoma	33.1

Sources: [1]<u>Human and Material Resources</u> series (17 counties), Technology Use Studies Center, Southeastern State College, Durant, Oklahoma.
[2]<u>Overall Economic Development Program</u> series, prepared by each county.
[3]<u>1966 Annual Report of Oklahoma State Board of Agriculture</u>, p. S-92.

Table III-33

Change and Percent Change in Number of Farms, Land in Farms, Average Size of Farms, and Value of Land and Buildings, 1950 to 1964

County	Number of Farms		Land in Farms (Thousands of Acres)		Average Size (Acres)		Value of Land and Buildings (Average Per Farm)	
	Change	% Change	Change	% Change	Change	% Change	Change	% Change
Haskell	- 770	-45.3	37	12.5	184.1	105.6	$26,140	654.6
LeFlore	-1281	-41.5	72	19.0	128.8	102.6	19,863	434.5
Muskogee	-1291	-44.8	13	3.4	115.8	87.7	24,474	285.5
Rogers	- 461	-22.7	- 22	- 5.5	43.6	22.1	24,957	182.7
Sequoyah	- 628	-30.0	52	19.8	88.6	70.6	21,924	518.4
Wagoner	- 679	-38.7	8	3.0	102.3	67.7	35,678	318.4
6-County Total	-5110	-37.7	160	8.0	108.1	73.6	24,860	343.4
Tulsa	-1836	-70.5	-116	-38.0	123.5	105.6	74,228	434.8
7-County Total	-6946	-43.0	44	1.9	112.1	78.9	28,337	408.3
State of Oklahoma	-53,520	-37.6	70	.2	153.6	60.7	37,985	192.0

Source: Same as shown in Table 3; Table 37.

Table III-34

Anticipated Land Use, by Type, by County, 1975

COUNTY	Cropland		Pasture-Range		Forest-Woodland		Other Land		Total	
	1975[1]	Change[2]	1975[1]	Change[2]	1975[1]	Change[2]	1975[1]	Change[2]	1975[1]	Change[2]
Haskell	53.8	-7.0	135.2	-4.5	149.1	-31.0	3.3	0.0	341.4	-42.5
LeFlore	123.8	16.6	183.6	16.5	444.4	-28.0	7.7	-5.0	759.5	.1
Muskogee	107.1	-37.3	196.2	41.1	55.2	-4.4	64.3	-8.5	422.8	-9.1
Rogers	105.3	5.4	251.6	9.5	43.3	-17.6	2.5	.5	402.7	-2.2
Sequoyah	63.3	5.2	127.4	80.4	203.2	-27.5	10.4	-57.9	404.3	.2
Wagoner	166.1	20.5	100.5	-12.7	49.0	-9.3	4.0	.6	319.6	-.9
6-County Total	619.4	3.4	994.5	130.3	944.2	-117.8	92.2	-70.3	2,650.3	-54.4
Tulsa	159.2	37.5	84.1	-46.8	34.0	-5.8	6.9	-.3	284.2	-15.4
7-County Total	778.6	40.9	1,078.6	83.5	978.2	-123.6	99.1	-70.6	2,934.5	-69.8
State of Oklahoma	13,949.4	-780.1	18,333.6	3,042.6	7,783.7	-1,607.9	827.0	-884.5	40,893.7	-229.9

[1]Thousand Acres.

[2]From 1958, in thousands of acres.

SOURCE: Oklahoma Conservation Needs Committee, Oklahoma Soil and Water Conservation Needs Inventory, July, 1962, Table 9.

Table III-35

Characteristics of Farms: Number of Farms, Land in Farms, and Farm Size and Value, Arkansas River Region of Arkansas, 1959

Geographic Area	Number of Farms	Acres of Land Area	Acres in Farms	Percent of Land in Farms	Average Acres Per Farm	Average Value of Land and Buildings: Dollars Per Farm	Average Value of Land and Buildings: Dollars Per Acre
Arkansas River Region	28,662	11,593,600	5,145,021	44.4	179.5	15,699	87.45
West Subregion	6,782	2,701,440	1,074,051	39.8	158.4	10,523	67.43
Crawford	1,316	382,080	160,603	42.0	122.0	11,508	100.34
Franklin	1,052	393,600	202,769	51.5	192.7	11,281	57.32
Logan	1,451	463,360	265,214	57.2	182.8	11,933	64.46
Polk	933	549,760	142,144	25.9	152.4	9,782	64.10
Scott	898	574,720	144,190	25.1	160.6	7,088	45.76
Sebastian	1,132	337,920	159,131	47.1	140.6	10,204	74.16
Central Subregion No. 1	5,186	2,263,680	904,143	39.9	174.3	11,285	64.74
Conway	1,201	358,400	235,834	65.8	196.4	12,136	70.19
Johnson	992	432,640	153,973	35.6	155.2	7,944	62.06
Perry	508	353,920	98,122	27.7	193.2	9,602	56.04
Pope	1,319	521,600	207,467	39.8	157.3	8,158	56.36
Yell	1,166	597,120	208,747	35.0	179.0	11,843	74.39

(Continued)

Table III-35 (Continued)

Characteristics of Farms: Number of Farms, Land in Farms, and Farm Size and Value, Arkansas River Region of Arkansas, 1959

Geographic Area	Number of Farms	Acres of Land Area	Acres in Farms	Percent of Land in Farms	Average Acres Per Farm	Average Value of Land and Buildings: Dollars Per Farm	Average Value of Land and Buildings: Dollars Per Acre
Central Subregion No. 2	10,855	3,816,320	1,963,607	51.5	180.9	16,419	90.76
Cleburne	1,063	380,800	179,826	47.2	169.2	9,275	54.05
Faulkner	1,746	413,440	286,992	69.4	164.4	10,750	68.51
Lonoke	1,814	512,000	377,698	73.8	208.2	29,313	153.15
Prairie	910	431,360	256,528	59.5	281.9	29,971	118.64
Pulaski	1,188	490,880	184,824	37.7	155.6	24,054	176.19
Saline	631	464,000	72,265	15.6	114.5	11,736	116.83
Van Buren	1,029	456,960	186,112	40.7	180.9	8,027	46.34
White	2,474	666,880	419,362	62.9	169.5	10,067	57.98
Central Subregion No. 3	5,839	2,812,160	1,203,220	42.8	206.1	24,294	113.0
Arkansas	1,213	662,400	449,712	67.9	370.7	57,633	155.86
Cleveland	773	384,640	93,704	24.4	121.2	7,202	65.70
Dallas	467	430,080	64,582	15.0	138.3	7,781	61.01
Grant	554	403,840	60,106	14.9	108.5	7,710	82.36
Jefferson	1,745	569,600	311,941	54.8	178.8	19,988	147.80
Lincoln	1,087	361,600	223,175	61.7	205.3	21,707	112.82

Source: U. S. Bureau of the Census, U. S. Census of Agriculture: 1959. Vol. I, Part 34, "Arkansas," U. S. Government Printing Office, Washington, D. C.

Table III-36

Arkansas River Region Mineral Production, 1964

County	Value	Minerals Produced (in order of value)
West Subregion		
Crawford	$ 2,762,320	Stone, natural gas, sand and gravel
Franklin	5,505,074	Natural gas, coal, stone, sand and gravel
Sebastian	1,826,230	Natural gas, stone, clays, coal, sand and gravel
Logan	1,322,792	Stone, natural gas, sand and gravel
Scott	116,000	Sand and gravel
Polk	72,533	Clays, stone, sand and gravel
	$11,604,949	
Central Subregion No. 1		
Johnson	$ 2,347,985	Coal, natural gas, stone, clays
Pope	1,581,208	Stone, natural gas, sand and gravel
Conway	382,325	Natural gas, stone, sand and gravel
Yell	536,061	Stone, sand and gravel
Perry	220,800	Stone
	$ 5,068,379	
Central Subregion No. 2		
Van Buren	$ 484,900	Stone, sand and gravel, phosphate rock
Cleburne	161,140	Stone, sand and gravel, natural gas
Faulkner	688,629	Stone, sand and gravel
White	326,638	Stone, sand and gravel
Saline	19,208,141	Bauxite, lime, sand and gravel, soapstone, slate
Pulaski	11,579,789	Stone, clays, sand and gravel, bauxite
Lonoke	1,136,917	Stone, sand and gravel, clays
Prairie	9,000	Sand and gravel
	$33,595,154	
Central Subregion No. 3		
Grant	$ 345,000	Sand and gravel
Jefferson	w	Lime, sand and gravel
Arkansas	56,000	Sand and gravel
Dallas	79,000	Sand and gravel
Cleveland	43,000	Sand and gravel
Lincoln	113,000	Sand and gravel
	$ 636,000	
Total for Region		$ 50,904,482
STATE TOTAL		174,789,000

[w]Withheld to avoid disclosure of individual operations.

Source: U.S. Bureau of Mines.

Table III-37

Value Added by Manufacture in the Arkansas River Region of Arkansas
(unit - $1,000)

	1954	1958	1963	Percent Change, 1954-1963
United States (millions)	$117,032	$141,500	$190,395	62.7
State of Arkansas	457,047	591,745	958,687	109.8
Arkansas River Region[1]	190,572	270,906	448,410	135.3
West Subregion	45,633	64,686	107,288	135.1
Crawford	1,697	3,705	4,046	138.4
Franklin	763	819	1,498	96.3
Logan	315	2,431	5,805	1,742.9
Polk	1,518	2,830	3,423	125.5
Scott	453	1,390	5,472	1,107.9
Sebastian	40,887	53,511	87,044	112.9
Central Subregion No. 1[1]	9,201	12,574	20,388	121.6
Conway	2,804	3,709	4,615	64.6
Johnson	1,608	2,629	3,044	89.3
Perry	60	63	(D)	
Pope	4,789	6,236	12,729	165.8
Yell	1,992	3,195	(D)	
Central Subregion No. 2[1]	105,949	150,555	224,929	112.3
Cleburne	456	366	1,502	229.4
Faulkner	4,325	7,492	12,915	198.6
Lonoke	1,103	1,367	(D)	
Prairie	333	234	2,007	502.7
Pulaski	67,556	102,852	149,157	120.8
Saline	27,665	33,969	44,632	61.3
Van Buren	448	517	(D)	
White	5,614	5,642	14,716	162.1
Central Subregion No. 3[1]	29,789	43,091	95,805	221.6
Arkansas	9,780	6,726	13,396	37.0
Cleveland	679	218	(D)	
Dallas	3,078	3,630	5,424	76.2
Grant	2,313	3,002	2,969	28.4
Jefferson	14,618	29,733	74,016	406.3
Lincoln	(D)	(D)	(D)	

[1]Does not include counties with incomplete data.

(D) - Not available in the source data.

Sources: U.S. Department of Commerce, Bureau of the Census, Census of Manufactures, 1963: Summary Series, General Statistics for Geographic Divisions and States (Preliminary Report), MC63(P)-4, Table 1, p. 3; Area Series, Arkansas (Preliminary Report), MC63(P)-54, Table 2, p. 5; 1958: Area Statistics, Arkansas, Vol. III, Table 3, p. 3-5; and 1954: Area Statistics, Arkansas, Vol. III, Table 3, pp. 103-4 and 103-5 (Washington: Government Printing Office).

Table III-38

Selected Indicators of Housing Improvements
in Rural Areas of the Ozark Region,
1950 and 1960

Condition of housing	1950	1960
Sound or deteriorating, with all plumbing facilities	83,324	247,686
Percent of total	15.9	47.1
Flush toilet, exclusive use	105,508	269,858
Percent of total	20.1	51.4
Bathtub or shower, exclusive use	113,518	267,599
Percent of total	21.7	50.9
Hot and cold water piped inside	101,351	270,211
Percent of total	19.3	51.4
Total housing units	523,940[1]	525,448[2]

[1]Includes farm and nonfarm housing units, occupied and vacant, located in rural areas for which data are reported in the 1950 Census of Housing. The number of nonreported units for 1950 is only a small fraction of the total.

[2]Includes farm and nonfarm housing units (occupied and vacant).

Source: U.S. Censuses of Housing, 1950 and 1960.

PART IV

THE RESEARCH

Given the background information on the river and the region through which it flows in Parts II and III, we are now ready to discuss the kinds of research which would seem needed if we are to be able to sort out the effects of the improvement of the river on the region's future development.

The importance of this material, and the reason for the considerable space given to it, is that it makes possible the positing of valid hypotheses regarding the kinds of impact one can and cannot expect from the ARDP. All analysis is to some extent judgmentally based, since even so thoroughly statistical an example as an economic model--if it is to be a good one--involves the selection of significant variables. And in the present investigation we must seek to factor out, after the fact, from the many events which will have occurred within the impact region--in many instances, events of a kind not approachable statistically--those which have occurred as a result of the ARDP.

This is the essential distinction between the kind of research we are talking about in this study and the traditional analysis of project impact, which has primarily been cost-benefit analysis projected toward a hypothetical future. Here, we must hypothesize about an immediately historical past and devise tests to determine whether what we think will have resulted from the ARDP has indeed been so derived.

All of the ensuing proposals and discussion operate, then, within a common methodological framework. Whatever the area of research, we must first select indicators which, given the complex of our background information, we can regard as significant. For each, we must then derive three sets of data: First, we must establish a set of baseline data representing the total phenomenon prior to advent of the ARDP. Second, we must derive periodic data for the total phenomenon representing, relative to the first set, gross changes at intervals following advent of the ARDP. Third, and representing the objective of the entire research, we must factor out from the second set of data those changes specifically attributable to the advent or operation of the ARDP.

At first glance, the third set would seem to pose the most formidable difficulties in designing methodologies and techniques, and in many areas of study this is indeed the case. Frequently, the exigencies of designing the third set necessarily condition the design of the first two. But in the present study--precisely because the projection is retrospective rather than forward--baseline data has often proved the most difficult to establish.

Baseline data--even of easily measurable quantities--are frequently available only at non-matching points in time, for discrete or overlapping periods of time, or for a highly various base of selection. Measurements of water quality, even in the mainstream, are an example: one finds that at no single checkpoint will all the items of a total survey have been noted, or then that the separate items checked at various stations will be impossible of correlation on a time scale. These are some of the problems of macroanalysis, while on the other hand the more refined the focus and techniques of a study become the greater the likelihood of baseline data not having been collected or even recognized as significant prior to development of the hypothesis. In many cases the nature and extent of available baseline data will delimit the scope and nature of the subsequent series, while in some cases its total lack will preclude the possibility of deriving either periodic or impact data.

The establishment of periodic data--sometimes called replication or monitor data--is also not without inherent difficulties. Often, exact replication becomes impossible because of changes in the fundamental characteristics of the item being studied. Also--and this is very frequent, even when the investigators themselves have been able to set the parameters of the baseline--intervening changes in the phenomena under study (usually technological change, since it is most rapid and influential) will bring about new or altered focal points of study, for which the baseline data have become inappropriate or inadequate. A case in point might be mercury content in testing for water quality. A "total" water quality survey set up three years ago would not have included this measurement. A simplistic example on a macroscale would be a study set up for a stream where seasonal low flows were critical: at a much later date, the streamflow might be so controlled as to become constant at a newly-derived optimum (say, to provide dispersal of domestic effluents), while in the meantime an atomic energy plant might have been located along the stream, with the result that water temperature had become of primary importance.

In short, methodological problems exist within each category of data, and it may clarify for the reader much of the following body of this study to recognize that it is throughout wrestling with these problems--working out, within each aspect of each field of investigation, adjustments to less-than-ideal conditions for the establishment of baseline, periodic and impact data.[1]

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[1]Attention of the research team is directed to an insightful discussion of the general problem, with guidelines for both baseline and replication studies, an October, 1969, publication of the Russell Sage Foundation: "Toward Social Reporting," by Otis Dudley Duncan.

The tradition of looking into economic impacts of water resource projects is longer, richer, and vastly more comprehensive than that with respect to impacts on other aspects of human behavior or environmental characteristics. For that reason, the recommendations under this heading are considerably more detailed than those in the newer areas of concern discussed in succeeding sections. Nevertheless, serious methodological, theoretical and technical issues are involved in formulating a research program aimed at assessing just the economic aspects of the ARDP program.

These complications, as discussed below, are more serious in the derivation of impact data, specifically in the identification of direct effects (as distinguished from indirect effects). Within the area of economic impact, baseline and periodic data do not pose truly formidable problems: most of the necessary information, once the significant indices of direct effects have been tagged, is readily available from standard statistical sources dealing with employment, production factors, labor force, etc. For both baseline and periodic data, however, there are two kinds of information which do indeed present a problem for this analysis: information about the role of transport costs (and possibly costs of power and water) in industrial production functions, and information on quantities and delivered prices paid in various market regions for the products of those industries affected by water transportation (and, again, perhaps of those affected by changing water and power supply costs). These difficulties are discussed later in this section, as is a problem encountered in regard to baseline data for the determination of ARDP impact on land values. The bulk of our presentation, however, beginning immediately below, is directed to the central problem--factoring out specifically ARDP-inspired economic impact.

Perhaps the most basic methodological problem is that the precise nature of the economic impacts which will manifest themselves over the future cannot be known in advance. This involves much more than the simple observation that we cannot now anticipate the exact amount of the impact; essentially it refers to the even larger issue of our not being able even to identify accurately the kinds of impacts that will occur. Moreover, since the range of conceivable economic impacts would be extremely large, it would make no sense to plan for a research design that would be capable of exercising surveillance over all facets of the region's economy and of such breadth that any conceivable impact would be picked up. Rather, at the outset there must be a preselection of likely impact areas so that research procedures can be devised that will give us good estimates of whether changes in these predesignated areas are or are not functions of the ARDP; and where they are, the extent to which that is the case.

This situation, however, is not as troublesome as it might appear at first glance since on the basis of our research we can judge the likely avenues of impact. With such an identification it is then possible to design a research project or set of projects which have some reasonable boundaries. On the basis of extended discussions among ourselves, with CE Staff and with others in and outside the area, and on the basis of the material we collected which is summarized in Parts II and III of this report we feel that the likely possible points of entry of the effects of the ARDP on the economy of the Arkansas Basin are:

1. The impact of improved water transportation on industrial, agricultural, and mining activities.

2. The impact of increased electric power capacity on industrial activities.
3. The impact of an increased water supply on industrial and agricultural activities.
4. The impact of changing water table levels on agricultural activities.
5. The impact of increased recreational use on income and expenditures in the region.
6. The impact of reduced cropland acreage on agricultural output.
7. The impact of reduced timber acreage on forestry and wood product industries.
8. The impact of changes in the structure of land values on income distribution and land use in the region.

Perhaps it should be emphasized once more that we are not predicting that these things will occur, but rather that they represent a reasonably exhaustive inventory of the kinds of effects of any quantitative significance that would be likely to occur.

Estimating the total impacts of the ARDP would include the estimating of the direct impacts under the above categories, but also given the interdependence of the whole economic system it would include indirect effects on various other categories of activity. For example, a new industry might locate along the river because of lower water transportation cost. It would pay wages and produce output--these would be <u>direct impacts</u>. But the workers in the plant would spend their income (or part of it) on goods and services, in general, and the plant would purchase some of its raw material from area suppliers. The income, employment and output arising from both of these kinds of expenditures would be <u>indirect impacts</u>. Moreover, these "first round" indirect impacts would produce still further increases in consumption and raw material demand, and these increases would lead to further increases, and so on.

The methodology for estimating indirect impacts, once the direct impacts are known, does exist.[1] Essentially this methodology involves an input-output analysis with some modifications. The modifications in the model described in Development Benefits for Water Resources Investments essentially were necessary because that model was designed to estimate future impacts of projects. In general such modifications could be described as being in two categories. First it is necessary, if one wishes to forecast the future,[2] to make some adjustments for labor supply response. In such a "forward" input-output calculation (that is, calculating new activity levels in all activities as a function of increased final demand in some activities) it assumes implicitly that the factors of production necessary to achieve such higher levels necessarily are available; essentially it assumes an infinitely elastic supply of labor. In any forward forecast this is clearly unsatisfactory, as the necessary labor supply may not materialize. Accordingly some labor supply model, including natural increase, labor force participation rates and net immigration, must be formulated and linked with the input-output model so that the predicted activity levels can be consistent with a predicted equilibrium labor supply.

The second kinds of modification involve the fact that input-output models are formulated in terms of linear homogeneous production functions. While these might be satisfactory for small movements, clearly they could cause severe inaccuracy in making long-range forward forecast where large changes might be expected. Also, even if linear at a point in time, the production coefficients

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[1]See Development Benefits of Water Resources Investments.

[2]Forward forecasting is not involved in this research as will be explained later.

might shift over time. However, since these modifications are necessary only where forward forecasting is involved, and since forward forecasting will not be involved in the research on the impacts of the ARDP, it does not seem necessary to go into them in detail here. In fact, quite the contrary: it would seem possible to use a straight unmodified input-output model as described in Chapter 6 of Developmental Benefits of Water Resource Investments for making the "backward estimates" which are contemplated in this research design. For example, if in 1980 we are attempting an estimate of the change due to the ARDP from 1970 to 1980, it is not necessary to adjust for the equilibrium labor supply response, since we already will know what was in fact the change in labor supply over that decade. Similarly, it is not really necessary to worry about the possibility of future change in input coefficients or linearity in input-output relationships, if we know the coefficients for both 1970 and 1980. The shift in those coefficients would itself tell us what combination of technologically and scale-induced shift in coefficients actually had occurred over the period.

Further simplification of the model design described in Chapter 6 of that earlier study may be possible as well, namely that the interregional dimension of the model may be collapsed into a two-region situation--the Arkansas River Basin and the rest of the world. It might be that there would be a collatoral interest in looking at the extra basin impacts on the rest of the Ozarks area, and the rest of the world excluding the total Ozark region, thus giving us a three-region case. But even that would be considerably simpler than the multiple region design described in the earlier model. And strictly speaking for analysis of impacts on the basin area alone, a two-region model would do.

It is the case, however, that at least the two-region model--the Arkansas River Basin and the rest of the world--would have to be calibrated at regular intervals by the research effort which is here being designed. From the work in the earlier report it would be possible to make a calibration for this two-region breakdown for the year 1963 without additional data collection, but only a recalculation of those results. Given the time that has passed, it would be desirable for a new calibration to be made now for as late a year as possible with future calibrations being made probably not more often than five and perhaps as infrequently as every ten years.

Another issue involved in periodic calibration of a regional input-output model for the ARDP involves the degree of disaggregation--that is, the number of industrial sectors. The existing 1963 model which is alluded to above and which could be recalibrated for the Arkansas River Basin has only 23 sectors. Surely more disaggregation is always preferred to less, but disaggregation is very expensive. The final decision of how much disaggregation there should be ultimately rests on the degree of detail with which the CE feels it needs to know the impacts. If all that seems necessary is a decent estimate of the total impacts of the ARDP on industrial employment in total, for example, a rather crude disaggregation would seem satisfactory, simply enough to provide enough interaction to give one a reasonable estimate of the total change attributable to the ARDP. In principle, this could probably be accomplished by something like the 23 sector model.[1] On the other hand, if the CE really wants to know the impacts on individual industries, at a minimum, those industries would have to appear as separate activities in the model and considerable additional detail would be required as well. One could easily get to a 60, 70 or 80 sector model and conceivably even larger, depending on one's tastes.

[1]Later we discuss the need for somewhat more disaggregation, but for other reasons.

It should be clear that there cannot be an objective technical judgment as to the optimal degree of disaggregation. It really depends on the degree of detail in which one wishes to observe impacts and since that will differ among individuals, their views as to how much disaggregation is required necessarily also will differ. In our judgment a large step forward in river basin planning could be made if we could only estimate impacts in a rather aggregative way and do it fairly accurately. It is for that reason that we would recommend only a modest expansion of the 23 sector model, with the burden of proof lying on those individuals who would want more detailed analyses to demonstrate why it was necessary.

There is another matter in regard to choosing sectors besides the degree of detail with which we wish to describe the impacts. Specifically it involves the way in which estimates of the direct impacts, to be discussed presently, can be linked up or "fed in" to the analyses of indirect effects. In short, if the analyses of direct impacts gives us estimates of expansion due to improved water transportation in categories like chemicals, wood processing, coal mining, etc. then those activities must appear as separate activities (separate rows and columns) in the input-output analyses if maximum use of estimates of direct impacts are to be obtained in estimating indirect impacts. If mistakes are made, of course, they are not necessarily disastrous. For example, if the analyses of direct impacts told us the expansion of the chemical industry due to the ARDP and our input-output analysis contained only a single row and column for manufacturing we could still make an estimate of the indirect impacts. We would simply interpret the expansion of the chemical industry as an expansion of manufacturing, in general. This would give us a less reliable but not a biased estimate of the impact. But clearly we would have a much more efficient estimating system if we had designed the input-output categories to include chemicals as a separate activity. But if we are to have our base-line data properly lined up with future data--that is, if our 1963 and current input-output tables are to be used with input-output tables constructed, say, for 1980 and 1990--we must decide on the probable categories now if these tables are to be both useful and consistent. In that regard a judgment must be made as to the industry classifications likely to be affected by the ARDP. It is for this reason that our judgment that most of the direct industrial impact will come by way of improved water transportation rather than water supply and electric power is important. The total capacity of the hydroelectric generating facilities in the project would amount to only a few percent of the electric power capacity of the region. While there would be a benefit to the users of such capacity, it seems unlikely that it could serve as a basis for an expansion of the region's industrial base. The ultimate answer to this question must be revealed by the future course of development and the research on it, but it would seem wasteful to us to expend much research effort on developing a capacity for analyzing expansion due to power-based industries, when it seems so likely that the power output of the ARDP could serve as a basis for such expansion. The situation seems similar with regard to the impact of increased industrial water supply as well. While the various reservoirs will add to that supply, the region in general is not short of industrial water, and so there is a fair chance that the increased supply may be largely redundant. Again, there is no way of knowing this in advance, but as in the case of electric power it would not seem sensible to invest a lot of research effort into being able to analyze industrial expansion based on increased water supply. It is only in the Oklahoma section that any such eventuality is likely at all, and even there we would judge that the effects would not be very large--we would take our chances on having to analyze any water-supply based industrial expansion which might materialize on a more rather than less generalized basis. In the case of impact of water supply on agriculture--which might be fairly significant in the western parts of the basin, there really is no problem, since agriculture would appear as a separate activity in the input-output model.

On the assumption that the bulk of the effects on industry will come from transportation and on the basis of the materials and information we have gathered in our research we would recommend that the input-output analysis should allow for the following as separate activity sectors: coal, logging, wheat, crude petroleum, sand and gravel, metallic ores, products of petroleum and coal, wood products, chemicals, and primary metals. These should be included as separate activities at least at the two-digit SIC level, and, if sources permit, at the three-digit level. Other activities could be combined into fairly highly aggregated sectors at about the level of the earlier 23 sector model referred to above. Thus, even describing many of the above activities at the three-digit level, it should be possible to have a model with no more than 40 to 50 sectors in total. This would involve some additional data collection for the recalibration of the 1963 model.

If such a model could be developed, it would be fully capable of estimating the indirect impacts that would be associated with any of the direct impacts contained in the initial inventory of possible points of direct impact entry. What remains to be discussed is the research needed in order to make the estimates of direct impacts.

<u>Impact of water transportation, water supply and electric power on economic activities</u>

Analyzing the impact of improved or cheaper water supply or electric power is somewhat different than analyzing the impact of lower transportation cost. The former essentially are equivalent to lowering the production cost for certain activities at particular points in a network of interconnected raw material, production and market locations. The latter, reducing transportation cost, is equivalent to lowering the cost of moving goods on certain segments of that network. In general, changing transportation cost along particular network segments will change the whole pattern of raw material supply points for each production location and the pattern of production locations for each market location. Hence they represent a much more complex kind of impact than simply lowering the cost of an input at a particular point.

A model for estimating the simpler situation, namely a lower input cost at one or more points, on the location of production has been developed. It too is described in <u>Development Benefits of Water Resources Investments</u> (see Chapter 5 of that report). Using that model for the research contemplated for estimating the impacts of the ARDP involves two important research problems, however. First, that model must be expanded to take care of changing transportation cost as well as lowering input cost in a more general way than in its present state. Second, a data base for motivating the model must be developed.

The data base required would essentially be that which was indicated in the discussion of the original model plus the specification of changing transport cost. Specifying the changes in transport cost is not an important problem and so the research problem reduces simply to developing the data base that would be necessary to motivate the initial model. While the data needed to make such a model operational are not generally available from conventional secondary sources, most of the items as described on pages 223 and 224 of the earlier study can be assembled relatively easily except for two items, namely production cost at each production location and demand for the product at each market. Making any programming model of industrial location fully operational would require a research and data development effort aimed at developing better basic sources of such information in general, or at least for those industries which are likely to be effective in the ARDP. Moreover, in the case of the production-cost information, even though only a two region model is contemplated, it is not realistic to think of describing unit production cost in the Arkansas River Basin by a single number and production cost elsewhere by a single number. So far as production costs in the basin are concerned there is no inherent problem since we will know after the fact where production has located or expanded and can, in principal, determine production cost at those locations. Insofar as production costs outside the region are concerned, clearly they cannot be characterized by a U.S. average, since moving of capacity into the basin would require not that it be at a lower production cost point than the national average but lower than alternative sites which, at the margin, would also be below average. Accordingly, for each industry affected by water transportation cost (or water supply cost or electric energy cost, if these were important), there would have to be a designation of a number of representative production points outside the basin and an attempt at gaining production cost data for those locations.

Insofar as market demand information is concerned, given that we are making backward estimates, it would not be necessary to have estimates of the elasticity of the demand in each market. However, again for each of the commodities affected, it will be necessary to know the quantity demanded and the delivered price in each of several representative markets in the United States.

One additional aspect of the needed information on production costs should be noted. In particular, if we are interested in the impact of transportation cost, it will be necessary to know not only the average cost of production at all representative locations, but also to know the importance of transportation cost relative to production cost as determined by the pattern of market locations.

If we were interested in the impact of reduced water or electric power cost, however, the production function information that would be needed would be more complex. In particular, we would have to know both the average and marginal product of water and electricity in the production of the various commodities concerned. This would involve extremely difficult research, and so, accordingly, unless one had reason to believe that the impacts of increased water or electricity supply on industrial location would be significant, one should be very hesitant about engaging in the very difficult research that would be needed to estimate these impacts. In any event, since at least changes in transportation cost are likely to be important, the programming model of the earlier study must be modified to include both changes in transportation cost and changes in capital capacity simultaneously.

We turn now to a specification of the kind of linear programming model which would seem necessary. It represents an adaptation of the earlier model referred to above. It should be noted that the exact form of the model might have to undergo slight modification for particular industries, but that will have to be part of the research effort itself. For now, we present a general notation of the kind of model needed. We start with a list of symbols to be used.

$_ic_R$ = cost of all intermediate goods required to produce one unit of good R in region i (i = 1,...I; R = 1,...,K)

$_ib_{rR}$ = quantity of primary good r required to produce one unit of good R in region i, (i = 1,...,I; r = 1,...,R; R = 1,...,K)

$_iR_R$ = unit value imputed to the physical capacity for the production of good R in region i

$_iW_r$ = imputed unit value of the endowment of primary good r in region i

$_iA_R$ = capacity for the production of good R in region i

$_jB_R$ = total demand for good R in region j (j = 1...J; R = 1...K)

$_iL_r$ = supply of primary good r available in region i

$_ie_r$ = unit price of primary good r in region i

$_{ij}S_R$ = cost of transporting one unit of good R from region i to region j

$_{ij}X_R$ = total quantity of good R produced in region i and shipped to region j

$_{ij}Q$ = transportation capacity of the link between regions i and j

$_{ij}Y$ = imputed quasi rent to one unit of capacity ($_{ij}Q$)

Each primary factor is assumed to be perfectly elastic in supply at its minimum price ($_ie_r$) up to a point, and perfectly inelastic thereafter. In contrast, cost of intermediate goods per unit of output ($_iA_R$) is assumed fixed for all outputs of (R)-final goods, which implies that the supply of intermediate goods is perfectly elastic for all quantities of output of (K)-intermediate goods.

Given minimum factor prices coefficients of production and transportation, transportation and production capacity constraints, total demands, and endowment constraints, it is desired to determine trade pattern (values of ${}_{ij}X_R$) and regional outputs of each commodity which will minimize total costs (total costs include both production costs and transport cost). The minimum cost solution is, of course, the same as the profit maximizing solution, and, strictly speaking, this would be achieved only under competitive conditions. On the one hand this is the only situation under which a tractable model can be developed. On the other hand, even though perfect competition may not hold in the affected markets this poses no problem if we can assume that the degree and pattern of adjustment to changing cost conditions is independent of the degree of competition.

The general linear programming model which can be solved for such a solution is as follows.

Minimize the linear function:

$$1)\quad C = \sum_{i=1}^{I}\sum_{j=1}^{J}\sum_{R=1}^{K} [({}_{ij}S_R) + (\sum_{r=1}^{R}({}_ie_r)({}_ib_{rR}) + ({}_ic_R)]\ ({}_{ij}X_R)$$

Subject to the constraints

$$2)\quad \sum_{i=1}^{I} {}_{ij}X_R \geq {}_jB_R \qquad (j = 1,\ldots,J;\ R = 1,\ldots,K)$$

$$3)\quad \sum_{j=1}^{J} {}_{ij}X_R \leq {}_iA_R \qquad (i = 1,\ldots,I;\ R = 1,\ldots,K)$$

$$4)\quad \sum_{R=1}^{K}\sum_{j=1}^{J} [{}_ib_{rR}][{}_{ij}X_R] \leq {}_iL_r \qquad (i = 1,\ldots,I; r = 1,\ldots,R)$$

$$5)\quad \sum_{R=1}^{K} {}_{ij}X_R \leq {}_{ij}Q \qquad (i = 1,\ldots,I;\ j = 1,\ldots,J)$$

6) $_{ij}X_R \geq 0$ for all i, j, R.

Each of the expressions above has an economic interpretation. The first expression (1) states that total cost of producing all commodities in all regions is determined by calculating per unit primary and intermediate production costs of every good (R) in every region (i), adding to this per unit transport costs to each region (j), and multiplying the total by the quantity of that good (R) shipped to each region. Summing over each--industry, shipping and receiving region, and primary factor--yields the total cost function of producing and shipping all goods to all regions. The second expression (2) states that the amount of each good shipped into any receiving region from all sources must be at least as great as that necessary to satisfy total demand (pB_m). Total demand includes both final demand, and derived demand for intermediate goods. Expression three (3) states that the amount of each commodity (R) produced in each region (i) must not exceed that region's capacity to produce it. Expression four (4) is a capacity constraint on each region's supply of primary factors. Expression (5) expresses the fact that the total quantity of all outputs shipped between any two regions i and j, cannot exceed transport capacity ($_{ij}Q$). Finally, expression (6) is the set of nonnegativity requirements.

In contrast to the primal problem which determines equilibrium regional outputs and quantities of inputs, the dual problem determines equilibrium delivered product prices ($_jP_R$), capacity quasirents ($_iR_R$), limitational primary factor quasi rents ($_iW_r$), and quasi rents to limited transportation capacity ($_{ij}Y$). Thus, while the primal problem deals with quantities of goods and is in real terms (i.e., outputs and inputs), the dual deals with imputed product and capacity values and is therefore in money terms.[1]

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[1]It can be shown that the daul variables are merely the Lagrangean Multipliers of constraints of the primal problem. For a detailed discussion of linear programming, see Hadley, G. Linear Programming; Addison, Wesley, 1962.

The Dual Problem is as follows:

Maximize

$$7)\quad M = \sum_{j=1}^{J}\sum_{R=1}^{K}(iP_R)(jB_R) - \sum_{i=1}^{I}\sum_{R=1}^{K}(iRR)(iA_R) - \sum_{i=1}^{I}\sum_{r=1}^{R}(iW_r)(iL_r) - \sum_{i=1}^{I}\sum_{j=1}^{J}(ijQ)(ijY)$$

Subject to the constraint:

$$8)\quad jP_R - iR_R - \sum_{r=1}^{R}(iW_r)(ib_{rR}) - (ijY) \le ijS_R + \sum_{r=1}^{R}(ib_{rR})(ier) + ic_R$$

$$(i = 1 \ldots I; j = 1 \ldots J;\ R = 1 \ldots K)$$

$$9)\quad jP_R \ge 0,\ iW_r \ge 0,\ R_R \ge 0,\ ijY \ge 0 \text{ for all } i, j, R, r$$

The purpose of the dual problem is to determine values of variables, jP_R, iR_R, iW_r, and ijY that maximize M subject to constraint (8). The constraint expresses the assumption that only values of jP_R, iR_R, iW_r, and ijY will be considered which satisfy the condition that the delivered price (jP_R) of each good delivered to region j will never exceed unit costs of producing it in region i and transporting it from region i to region j. Here the term "costs" include transport costs from region i to j, imputed values of primary factors in limited supply, costs per unit paid for intermediate goods used as inputs in production of R, inputed quasi rents to capacities in region i, maximum direct costs of primary factors, and imputed values to limitational transport capacities.

Notice that the two terms $\sum_{r=1}^{R}[ib_{rR}][iW_r]$ and $\sum_{r=1}^{R}[ib_{rR}][ie_r]$, in expression (8) are associated with the use of immobile primary resources (r). The minimum price (ie_r) is assumed to be exogeneously determined so that if any of a resource is used, it will cost the user at least (ie_r). As stated earlier, (ie_r) is essentially the opportunity cost of employing resource (r) in a given activity.

In contrast, the imputed value (iW_r), is a scarcity payment to factor (r). Hence the user of resource (r) in region (i) must pay a price ($ie_r + iW_r$) per unit of resource employed.

The imputed value to transport capacity (ijY) is positive only if traffic is sufficiently dense that the capacity is fully utilized. This occurs when congestion sets in. If the transportation system is publicly owned, and transportation rates are set exogenously by government at a level say (ijS_R) which reflects the opportunity costs of supplying the transport services, then the imputed values (ijY) are a measure of social costs (congestion costs) which constitute a waste to society resulting from overcrowding. If, however, government were to set prices (ijS_R) to a level that would eliminate (ijY), no excess demand for transport services would exist and the resources which were previously wasted would be appropriated as revenue to the government. Society would therefore be "better off" since resources absorbed by congestion costs could instead be used by government to produce additional goods and services.[1]

The value (ijS_R + ijY) provides a measure R of the cost to the shipper of transporting a good (R) from region (i) to region (j). It is analogous to payments by producers to owners of a primary factor. However, in this case, (ijY) is not collected by government if the government charges only (ijS_R). Instead it is wasted in the form of added labor costs, transit time, etc. resulting from congestion. In contrast, (iW_r) is in fact paid to owners of (r) and constitutes a quasi rent. Its level is determined by competition, and it is paid to owners because owners are legally allowed to appropriate it

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[1]See Knight, F. H., Some Fallacies in the Interpretation of Social Costs, AEA Readings in Price Theory, Irwin, 1952.

as an economic rent. The distinction therefore lies in who owns the resource. However, if government bases its pricing on the marginal social cost of producing the transport service, the outcome would be the same as if the resource were privately owned and operated.

Thus far, we have developed a linear programming model that can be solved for equilibrium values of regional outputs and prices. The solution assumes that all parameters and constraints are constant. We will now consider effects on the system resulting from changes in either a parameter or a constraint.

Such a change will affect the system through changes in the minimum value of C. Minimization of C will force a readjustment of variables (ijX_R) to a new set of equilibrium values. It is through changes in system costs, therefore, that effects from changes in capacities, transport costs, transport capacities and demands are identified.

We will begin by examining the effect on system cost resulting from a unit change in capacity (iA_R). Assume that the capacity does in fact possess a positive quasi rent, for if it did not, it would be in excess supply and further expansion would have no influence on system cost.

The incremental increase in capacity in region i will result in an expanded output by that region which must be offset by a corresponding reduction in output in some relatively higher cost region because final demands are assumed fixed. The extent of the reduction in systems cost (dC) resulting from the increase in capacity $d(iA_R)$, can be shown to be:

10) $\frac{dC}{d(iA_R)} = -iR_R.$ [1]

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[1]This statement will not be proven here. For proof see Herter and Moses, op. cit.

Since (iR_R) is the per unit quasi rent to capacity $(i\Lambda_R)$, it is obvious that the values of the dual variables possess properties that greatly aid in the interpretation of a linear programming problem.[1]

Before considering the effect on system costs resulting from a change in transportation cost (ijS_R)--the effect we are mainly interested in--certain interdependencies that exist between unit transport costs should be considered. Despite the simplifying assumptions made earlier regarding problems of "locating" transportation costs, it still remains true that if part of a route between region (i) and region (j) coincides with the route from say region (p) to region (q), then in most instances, a decline in (pqS_R) will result in a decline in (ijS_R). Furthermore, a decline in (ijS_R) will often result in a decline in the price (ijS_m) of shipping a different good between the same two regions. These relationships can be summarized by equations of the form: $ijS_R = ijf_R(pqS_m)$. This relationship expresses dependence of costs of transporting a unit of good (R) from region (i) to region (j) on the cost of transporting a unit of some good (m) from region (p) to region (q).

The impact on system costs (C) resulting from a small change in transport costs (pqS_m) can be shown to be the following:

11) $$\frac{dC}{d(pqS_m)} = \sum_{i=1}^{I} \sum_{j=1}^{J} \sum_{R=1}^{K} (ijX_R)\left[\frac{d(ijf_R(pqS_m))}{d(pqS_m)}\right].^2$$

A similar problem concerning interrelationships of transport links between regions exists when a transport capacity (pqQ) is changed. It can be shown that the following equation holds.

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[1]On the formal properties of these qualities, see Hadley, op. cit.

[2]Again, we will not prove this statement. See Herter and Moses, op. cit.

$$12)\quad \frac{dC}{d(pqQ)} = -pqY - \sum_{\substack{i=1\\ i\neq p}}^{I} \sum_{\substack{j=1\\ j\neq q}}^{J} [ijY] \left[\frac{d(ijQ)}{d(pqQ)}\right].^{1}$$

In the above expression, note that capacity of a link connecting regions (i) to (j) (i.e. ijQ) is assumed to vary with changes in (pqQ). This is an analogous concept to the change in transport cost between regions (i) and (j) resulting from a change in costs between regions (p) and (q).

Since the last two equations above are both concerned with the transport system, some elaboration is needed on the distinction between them. Let us begin by considering three possible situations that can exist on any given link. First, at the prevailing exogenous transport cost (ijS_R), congestion exists on the link which means that the link is being used to capacity. In such a case, a quasi rent (ijY) will be imputed to the capacity (ijQ). In such a situation, an increase in capacity (ijQ) will reduce system costs. As discussed earlier, if (ijS_R) is set at the economic opportunity cost of providing transport services, then the quasi rent (ijY) measures congestion costs that constitutes economic waste to society in the sense that no one benefits by the congestion. If, however, (ijS_R) does not reflect opportunity cost, then the value of (ijY) will correspondingly be affected so that (ijY) alone will not measure "true" congestion costs. In any case, the existence of (ijY) indicates that congestion exists at the regulated transport cost level of (ijS_R) and can be reduced by expanding capacity (ijQ).

In the second situation the transport link has excess capacity and yet opportunity costs of providing transport services equal the regulated price charged to shippers. If the regulating agency always prices at marginal social costs, then the only way to reduce transport costs is to invest in a technologically advanced system. Quasi rents (ijY) will be zero here so that increasing (ijQ) will not affect system costs.

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[1]See Herter and Moses, op. cit.

In the third case the link may not be used to capacity and opportunity costs of providing services may be less than charges made to shippers. In this case, transport costs may be lowered simply by altering the rate charged.

In the first case, equation (12) is relevant since system cost can be reduced by expanding capacity. However, as seen above, there is some difficulty in interpreting the meaning of the quasi rent (ijY). Also, if cost (ijS_R) were reduced and capacity (ijQ) were held constant, (ijY) would rise as a result of increased congestion so that costs to shippers may not be reduced (e.g. (ijS_R) will decline but (ijY) will rise because of increased waiting time, etc.). Hence the only feasible solution consists of increasing capacity (ijQ). In the second and third cases, equation (11) is relevant since, for both cases, (ijY) = 0 so that reducing (ijS_R) will reduce transportation costs to shippers. Hence system costs will be reduced.

Finally, consider the effect on system costs of a shift in demand. It is clear that if demand (jB_R) increases, the additional output must come from the highest cost industry since by definition, the fact that lower cost regions are all earning capacity quasi rents implies that they are operating at capacity and therefore cannot further expand output. Similarly, the fact that the highest cost region is not earning a capacity quasi rent implies that there is some excess capacity. Assuming that the excess capacity is sufficient to accomodate a small increase in demand, it can be shown that the following equation is true:

13) $\frac{dC}{djB_R} = jP_R.$

Given that demand has risen, there is no assurance that capacity will expand sufficiently to accommodate the increased demand. Consequently an added assumption must be made that supply will expand sufficiently to meet the increased demand. The problem of determining the region in which supply is to be increased is based on comparative rates of return to investment and will be discussed later.

Quasi rents used as a measure of the reduction in system costs resulting from changes in constraints and parameters can be applied as indicators of the relative return on investment in alternative uses. We will now consider this problem in connection with investment in regional industry capacities.

The cost of capital required for an investment serves as a measure with which to compare quasi rents to determine the rate of return from alternative investments. If cost of a unit of capital is the same in all regions, the system of quasi rents serves as a guide to the most profitable investments. If, however, rental costs per unit of capacity vary between industries or regions, then the system of quasi rents can be transformed into a system of quasi rent per dollar of rental cost per unit of time.[1] That is, if (pVk) is the current market value of one unit of capacity used to produce output (R) in region (p), (i) is the rate of interest, and (d_R) is the rate of annual depreciation, then the annual cost, (pe_R) of using the 1 unit of capacity is:

$$pe_R = pV_R(i + d_R).$$

Quasi rent per dollar of rental cost therefore is:

$$\left(\frac{pR_R}{pe_R}\right).$$

Suppose that quasi rents or quasi rents per dollar of rental cost are ranked for all industries and regions, and that there is a fixed sum of money

[1]See Herter and Moses, op. cit.

to be invested which will be allocated to regions and industries according to the magnitude of their quasi rents per dollar rental cost of capacity. As explained earlier, to be operational, the model must assume that the highest return region and industry will first be selected for investment. However, additions to capacity cannot be made without limit because, assuming total demands constant, each increase in capacity in one region and industry must reduce output produced in the same industry by some other higher cost region. When one of the non-zero outputs in one of the regions is reduced to zero, the basis for the linear programming solution changes and all outputs, imputed prices, and quasi rents must be recomputed. The formal criterion for dealing with this sort of problem is present below.

Suppose that investment in capacity in the industry and region with the highest imputed value per dollar has resulted in a reduction to zero in the output by the same industry in some other region. Further, suppose that the new equilibrium solution values have been computed, and that the region and industry with the highest imputed value per dollar cost of capacity in this next solution has been found. This latter highest imputed value per dollar is then compared with the second highest imputed value per dollar in the original solution. If the highest imputed value per dollar of the new solution is higher than the second highest imputed value per dollar of the original solution, then units of capacity can be added to the highest valued capacity of the original solution until the solution basis is changed so that subsequent additions to capacity can be made to the highest imputed value per dollar of the new solution. In this way, additions to capacities result in the maximum reduction in system cost. If, however, the second highest imputed value per dollar in the original solution is higher than the highest imputed value per dollar of the new solution, then units are added to the capacity with the highest imputed value per dollar of the original optimum up to the point where adding a unit will change the basis. Subsequent additions are made to the capacity with the second highest imputed value per dollar. Similarly, if the third, fourth, fifth, etc. capacities of the original solution command imputed values per dollar higher than the highest imputed value per dollar of the new solution, then units of capacity are added to those industries and regions until adding a unit to each would require a change in the basic solution. By adding to capacities in this manner, the greatest reduction in system cost per dollar is achieved.[1] Consequently, if for example, it is desired to allocate a sum of (Z) dollars, the above scheme will result in a maximum reduction in system costs.

The above procedure for allocating a fixed sum of funds for investment in capacity can also be extended to investment in the transport system.[2] Keeping in mind problems of interpreting the meaning of investing in transport capacity ($_{ij}Q$) or per unit transport costs ($_{ij}S_R$) described earlier, the effect on system costs resulting from changing either of the above variables can be compared to the opportunity cost of providing the capital required to effect the change. If adding capacity (equation 12) is required to reduce system cost, the cost might be very high. In contrast, if the regulated rate ($_{ij}S_R$) is at a level above opportunity cost, a reduction can be accomplished by merely reducing ($_{ij}S_j$). Finally, if excess capacity exists and ($_{ij}S_R$) is equal to the opportunity cost of the resources required to provide the transportation services,

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[1]See Herter and Moses, op. cit.

[2]While the change in the transport system in the ARDP presumably is "fixed" this aspect of the model could have applications in other situations.

reducing (ijS_R) can be accomplished only by technological advances. This assumes that the government is not subsidizing the transport system. If ijS_R is reduced below its opportunity cost, the difference must be made up by a subsidy from other sectors of the economy to the transport system.

Finally the problem of determining the region in which capacity should be increased to accommodate a change in demand will be described. Since the industry in the highest cost region is not earning a quasi rent to capacity, we have assumed that there is sufficient excess capacity to accommodate the increased demand. However, it has also been assumed that each increase in demand will bring forth an investment in a corresponding quantity of capacity (i.e. $\Delta jB_R = \Delta iA_R$). The question is, in which region will this capacity ΔiA_R be allocated? The solution is to allocate the investment to that region which maximize quasi rents per dollar invested in industry R.

A method of determining the optimal region consists of adding in the increased demand to the demand constraint of the programming problem (equation 2) e.g. $(jB_R + \Delta jB_R)$, and solving for an equilibrium set of outputs and prices. Next, compute profits per unit of capacity in industry (R) and allocate the added capacity $\Delta A = \Delta jB_R$ to that region with the highest quasi rent per dollar invested.

Consider now an alternative method of allocating a fixed sum (Z) of dollars which incorporates costs of capital into the linear programming model. If the annual cost per unit of capacity in industry (R) and region (i) is (iZ_R), and the number of units of capacity to be added in that industry and region is (iY_R), then the cost of adding (iY_R) units is $(iZ_R)(iY_R)$. Since Z dollars are available for investment, we know that $\sum_{i=1}^{I} \sum_{R=1}^{K} (iZ_R)(iY_R) \leq Z$.

i.e. the total number of dollars invested must not exceed the total number available. The linear programming model (equations 1 to 9) can be modified to include such a cost of capital function. The only changes required are the objective function (equation 1) and the addition of another constraint. The new equations are as follows:

1. Minimize

$$C + \sum_{i=1}^{I} \sum_{R=1}^{K} (iZ_R)(iY_R) \;.$$ [1]

2. The following constraint must be added

$$\sum_{i=1}^{I} \sum_{R=1}^{K} (iZ_R)(iY_R) \leq Z \;.$$

The remaining constraints of the primal problem are unchanged. Some care must be taken in defining the precise meaning of (iZ_R). (iZ_R) is the current cost of a unit of capacity. This definition is analogous to the one developed earlier in connection with the annual cost of using one unit of coal bearing land. It is approximately equal to the following expression:

$$iZ_R = \frac{(r+d)}{(1+r)}\, iV_R \;.$$ [2]

Thus (iZ_R) is the rental rate required to hold a unit of capacity in use (R) in region (i). If after the capacity is put in place, the return (i.e. quasi rent) to that capacity is less than (iZ_R), then the entrepreneur will not replace the unit after it has worn out.

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[1] See Herter and Moses, op. cit.

[2] Alternative definitions of the above relationship can be developed depending on assumptions regarding threats of deprivation. See R. G. D. Allen, <u>Macroeconomic Theory</u>, Chapter 4.

An implicit assumption in the above methods of allocating a fixed investment to the highest investment return industries and regions is that the model includes most of the important existing industries or potential industries in each region. In fact, however, the model we have developed will include only those industries whose outputs are thought to be economically related in an important way to the particular project under consideration, in this case the navigation project primarily. Consequently, it seems somewhat unrealistic to assume that all of the investment of a given sum of dollars will be allocated only to the included industries.

We will now develop a somewhat different investment scheme that attempts to circumvent this problem. In this scheme, it will be assumed that those investment funds generated endogenously by a particular industry will be invested only in that industry. That is to say, investment is specialized to a given industry but not to a given region. This assumption is consistent with the hypothesis that since firms in a particular industry possess a pool of trained labor, they enjoy a comparative cost advantage relative to other firms in investing in their industry and, conversely, a comparative cost disadvantage in investing in other industries. Anyway, while formally needed for the model and very troublesome for forward predictions (it probably is not true) it is not troublesome for backward estimation since we can specify *a priori* the amount of investment that would take place in each industry. In our application it would already have taken place.

Suppose that equations (1) through (9) have been solved for an equilibrium set of outputs and prices. For all industries and regions assume demands are fixed, and that the rate of depreciation in each region and industry (id_R) is given--in our applications, again, depreciation can be pre-specified.

We will consider an arbitrary industry (R), and region (i) and define the following relationships:

1. Let $(id_R)(iV_R)(iA_R)$ be the annual quantity of depreciation funds to be generated by revenues from industry (R) in region (i) to be used to replace depreciated capacity. That is we will have observed that a given percentage of the value of capacity wears out during each period. The sum is to be used for replacement investment in the same industry during the period following this period it was generated.[1]
2. Let $iV_R[ir_R + id_R]$ be the annual cost of capacity in industry (R) and region (i).
3. Let $i\pi_R = iR_R - iV_R[ir_R + id_R]$ be a measure of the economic profit per unit of capacity, where (iR_R) is the quasi rent per unit.

We assume that investment decisions by each industry and region consisted of replacement investment, investing some portion of industry profits, and investing some quantity of funds available from financing through the capital market. Thus total investment funds that would have been used in region (i) and industry (R) because of falling transport costs can be described by the following equation:

$$iI_R = (id_R)(iV_R)(iA_R) + (i\alpha_R)(i\pi_R)(iA_R) + (i\gamma_R)\left(\frac{i\pi_R}{iV_R}\right)(iV_R)(iA_R)$$

The second term on the right hand side, $(i\alpha_R)(i\pi_R)(iA_R)$, is similar to the financial concept of undistributed profits except that it applies to an entire industry. The third term, $(i\gamma_R)\left(\frac{i\pi_R}{iV_R}\right)(iV_R)(iA_R)$ is a measure of access of the industry to the capital market. $\left(\frac{i\pi_R}{iV_R}\right)$ is the rate of profit per unit of capacity; $(iV_R)(iA_R)$ is the value of the capacity, and $i\gamma_R$ is

[1]Many of the concepts underlying the investment model presented here were developed with the help of Professor J. Barr of Washington University.

a measure which expresses the amount of debt and equity financing that the industry has obtained.

Notice that the investment equation possesses the property that if capacity had expanded to the point where profits approach zero, net investment would also approach zero, and replacement investment only would constitute total investment. Summing over all regions, we have

$$\sum_{i=1}^{I} {}_iI_R = I_R$$

which is total investment available to industry (R) from all regions.

Given the quantity I_R of investment funds which have been available for industry R, a model which allocates the funds according to the criterion of maximum profits per dollar of capacity (i.e. $\left(\frac{{}_i\pi_R}{{}_iV_R}\right)$) is presented below.[1] In this model, investment funds for industry (R) are channeled into the region with the highest quasi rent per dollar investment.

We define a variable (${}_iZ_R$) which is the cost of using a unit of capital in region (i) and industry (R). It was shown earlier that ${}_iZ_R = \frac{({}_ir_R + {}_id_R)}{(1 + {}_ir_R)} ({}_iV_R)$.

Maximizing the product of profits per unit of capacity and the total annual cost $({}_iZ_R)({}_iY_R)$ of adding (${}_iY_R$) units of capacity, will yield an equilibrium set of capacity additions (${}_iY_R$) in which profits of industry (R) are increased at a maximum rate.

The following model which consists of K linear programming problems (one for each industry is presented below.

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[1]It is this "profit-maximizing" investment in the Arkansas River Basin compared with actual investment in that area that enables us to "factor-out" the effect on investment of the cost reduction aspects of the ARDP.

Maximize:

$$\sum_{i=1}^{I}\left(\frac{i\pi_R}{iV_R}\right)(iZ_R)(iY_R) \quad (R = 1\ldots K)$$

Subject to the constraints

$$\sum_{i=1}^{I}(iZ_R)(iY_R) \leq I_R \quad (R = 1\ldots K)$$

$$\sum_{R=1}^{K}\left[\left(\frac{ib_{rR}}{iV_R}\right)[1 - id_R]\;(iV_R)(iA_R) + (iY_R)(iZ_R)\frac{(1 + r_R)}{(ir_R + id_R)}\right] \leq iLr$$

$$(i = 1\ldots I,\; r = 1\ldots R)$$

The equilibrium solution to the problem will yield values of (iY_R) which will maximize profits for the industry as a whole. The first constraint expresses the requirement that total investment in all regions must be no greater than funds available. The second constraint requires that investment in all industries in any particular region must be consistent with resource endowments. There is some difficulty, however, in interpreting the second constraint. There would be no difficulty if all industries in the region that employ the resource were included in the model. However, the restrictive nature of the model implies that for many resources that is not the case. For example, labor is used by many industries that would not be included in our research program. A way around this problem is to assume that those resources which are used mostly outside of the industries included in the model have no limitational constraints. For instance, if all industries combined included in the model employ only a small portion of the labor force, then for our purposes, we could assume that the supply of labor was perfectly elastic. If, however, all industries included in the model employ a large fraction of a particular resource, then account can be taken of the existence of other users by adding a constant term to the left hand side of the second constraint which is a measure of the quantity of the resource used by industries excluded from the model. If all of any resource is employed by one or all of the industries included in those for which programming models have been formulated, it can be included in the constraints without modification.

The needed research would involve the exact specification and development of the necessary data base, as discussed above, of a linear programming model of the general type just described for each industry expected to be influenced by a change in water transportation rates. If any of these same industries were also affected by a change in the supply of water or electric power associated with the ARDP, the effects of such changes could be analyzed easily within the same linear programming format, although some additional production-function data would also be needed, as indicated earlier. If, in addition, there were other industries that would be affected by water or electric power changes, but not by water transportation, it would be necessary to construct additional programming models for those industries. Given our judgment that changes from these forces are not likely to be quantitatively significant, we would put low priority on extending the programming analysis to industries not potentially affected by water transportation change, at least in the initial stages of the research.

One final note on the impact of lower water transportation cost is in order. Specifically, it has been argued by many that when new water transportation facilities which would lower water transportation cost and increase carrying capacity are introduced, there frequently is a competitive response by railroads with a subsequent decline in rail shipment rates to bring them more in line with rail costs. To be sure such reduction of rail rates is beneficial to the region and is likely to stimulate economic activity. Whether one wishes to attribute such effects and benefits to the waterway is of course a difficult philosophical question. In any event, analyzing the impact of lowered rail rates would require an order of magnitude increase in the scale of the estimation of direct impacts and in the level of disaggregation in the input-output model for estimating indirect impacts. The reason for this is simply that the number of industries potentially involved is very much greater. Even with a rather aggregated model, the indirect effects of increased activitie in particular industries could be roughly calculated when the input-output model is designed only to show details in categories likely to be affected by water transportation. On the other hand, estimating the direct impacts of rail transportation rate reduction would require many additional industries studies and many additional calibrations of the industrial location programming model. It is our recommendation that such work should not go forward, at least until there is potential evidence that rail rates have in fact declined as a consequence of the lower water transportation rates.

Most of the expertise required for economic impact studies would consist of expertise on technique rather than on the details of the Arkansas Basin itself. In large part this is because of the fact that the economic impact studies are more "standard" than others, even if very difficult.

The references in Development Benefits of Water Resources Investments essentially can serve as the basic source document for relevant techniques and individuals. In particular we should cite David Greytak, now at Syracuse University, as especially familiar with the kind of input-output models needed. Also, one might check with the Harvard Economic Project under the direction

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of Wassily Leontief as the major source of data collection of this type. Also, in developing techniques for the programming analysis of industrial location, one should check with the National Water Commission as they are presently planning a research project aimed at developing such programming capacity. Finally, some consultive help might be needed on the particulars of the area and in that regard John Peterson of the Arkansas Development Commission would be very highly informed on Arkansas and knowledgeable of other people familiar with the Basin area.

The impact on land values

There are a number of reasons for investigating the impact of the ARDP on land values. Shifts in the value of land may well register some effect on the distribution of wealth and income. They will to some extent influence patterns of settlement, and so register impact on a social structure already, as we have seen, very much in flux. Finally, and parenthetically, they may already have affected project costs, and may affect industrial and recreational development costs in the future.

In this investigation, the establishment of baseline data is seriously hampered by the lateness of initiation of the study. As implied above, there are two general kinds of impact on land values: the impact occasioned by the planning and construction phase of the ARDP, and that occasioned by the post-construction, operative phase. Clearly, all impact of the first kind has already taken place, as a result of which we have posited, for each sample area studied for impact on land values, a baseline time series beginning in 1944--two years prior to authorization of the multi-purpose project. It is equally clear that this series, to 1970 (and incorporating impact data of the first kind), would then provide baseline data for the second, or post-operational, kind of impact.

Sections which follow present two methods for conducting the investigation--comparative analysis and multiple regression analysis--each of which has inherent difficulties of application to the Arkansas River Region; but for each, the baseline must be established at this point of Congressional authorization. It will be seen that this retrospective survey, involving the tracing of not one but several variables, poses precisely the problem of the multiple regression type of study. And it is also why a flat recommendation cannot be made between the two approaches: it is not possible to predicate the adequacy of available records for variables which can be selected only on the basis of their local significance. Unfortunately, there does not exist a third methodology; but even if there were an alternative approach to the problem, data collection would still have to start with a time series beginning in 1944, for there can exist no other meaningful baseline.

The only rational proposal which can be made, then, is that data adaptable to either method be undertaken, in the process of which it should become possible to determine which approach is most productive.

Specifically, we suggest that research on land values in the Arkansas River Basin focus on the following:

1. The extent to which increases in the price of land favorably situated to benefit from the project occurred prior to completion of the project; and
2. The long-run impact of the working project on land values in the basin.

Since, however, sample areas proposed for study of the two kinds of impact are the same, the two are distinct only as a division of the time series--to wit, the impact registered before 1970, when the ARDP became operative, and that registered after. Methodologically, of course, there is one further distinction: impact attributable to development of the project must be factored out from the land value trends observed prior to 1970; but the totality of trends observed to that data--that is, the unfactored observations--then becomes the baseline for researching impact attributable to the operating project, which must be factored out of data collected from 1970 forward.

The sections which follow are, then, divided not by consideration of the two kinds of impact but in terms of the two kinds of approach to the research. The comparative analysis is first considered, then the analysis by multiple regression, after which procedures are detailed. Whenever possible, cost estimates for the work are presented; but these are necessarily rough and partial.

An ancillary problem, not strictly within the focus of the present study but still of immediate corollary interest to the CE in its future planning for similar and lesser projects, is the question of the effect of CE land acquisition policies on overall project costs. The problem has deeply engaged the attention of members of our research-design force working in this area and they have developed the plan for a not costly and relatively simple study which should prove fruitful to the CE in future projects involving extensive land acquisition. This study design is presented as Appendix E.

Procedures for ascertaining long term trends in land values

A. General Considerations

Activities usually choose a particular site on which to locate for a complex of reasons, of which savings in transport cost is only one. Moreover, as regards transport costs, the towns and many of the potential port and industrial sites along the Arkansas are also serviced by one or more railroads and by a limited-access interstate highway paralleling the river that is nearing completion concurrently with the Arkansas Basin project. Add to this the fact that Arkansas and eastern Oklahoma are low-wage areas with towns and cities that in recent years have been avidly engaging in various subsidy schemes to attract industry, and it is evident that factoring out the influence of the Arkansas River Basin project from other forces that may affect the region's land value trends is a difficult task.

Two general techniques are available for such analytic factoring; the comparison method and multiple regression analysis. As regards the Arkansas Basin Study each has its virtues and limitations as will be discussed below.

The Comparison Method:

This method, analytically crude but simple, can be applied along three dimensions:

1. For selected towns and potential port and industrial sites along the river, the trend in land values before, during and after the completion of the ARDP can be compared.
2. Within these selected areas, trends in the gradient of land values from the river inland to the parallel interstate highway can be measured over time.

3. The river towns can be compared with communities in the same general region of similar size and pre-project population growth, that are on a mainline railroad and interstate highway but not on a navigable waterway.

Selecting appropriate locations for comparison involves two additional complications. The first is that the incremental impact of an improvement like the ARDP is likely to be less dramatic on large communities than on small ones. The forces affecting the trend of land value in metropolitan areas the size of Tulsa, Little Rock, or even Fort Smith are probably too varied and diffused to allow even a crude factoring out, via the comparison approach, of the incremental impact of navigation developments from the complex effect of their further growth as governmental centers, as corporate headquarters towns, marketing and cultural centers, or from other agglomerative trends. Moreover, the difficulty is compounded by a simple lack of comparison cities in the region even broadly similar to these SMSAs.

Multiple regression analysis appears, therefore, to be a potentially more promising method of assessing the differential impact of the ARDP on land values of these SMSAs than the comparison method.

Tulsa may be an exception, however, since its port of Catoosa is in an agricultural area a few miles removed from the current limits of urban settlement in the northeast quadrant of greater Tulsa. It would thus seem feasible to compare the trend of land values around Catoosa with that of a sample area of similar size equally distant from the boundaries of urban settlement--perhaps in the southwest quadrant of the Tulsa SMSA, since both quadrants are serviced by mainline railroads and turnpikes.

The second complication stems from the time span of the proposed impact studies. SWDPL-E letter of 27 March 1969, subject: "Proposed Arkansas River and Tributaries Navigation System--Economic Impact Study," indicates a very long time horizon, through the year 2000, for the data collecting and impact studies. This suggests that initially it will be necessary to cast the data collecting net rather widely. In the first place, at this early data one can only dimly foresee which sites along the waterway will receive major long-run impacts. Secondly, many of the potentially important sites are located in areas that to date have had low rates of turnover of property, so that to obtain enough annual observations to construct statistically reliable time series on land value trends at these sites it will be necessary, for a time at least to combine data from a number of the sites. As development takes hold, however, the growth points will become more readily identified; land turnover at some of these sites will increase; and the construction of less aggregated series might then be possible.

Multiple Regression Analysis:

This approach requires specifying an array of independent variables that are believed to affect the trend in land prices. While most of the independent variables should, like the dependent variable, be quantified annually, the flexibility of the analysis can be augmented through the use of dummy variables to measure the effect of quasi-qualitative variables or of those undergoing abrupt infrequent shifts. The multiple regression approach seeks to isolate the relative influence of variations of each of the independent variables on variations of land prices.

Multiple regression analysis is potentially a much more precise technique for estimating the incremental impact of the project on land values than simple comparison. In particular, it can capture incremental effects which the comparison method might overlook. But it requires a wide range of statistical information, and unless the regressions are based on an analytic model which accurately specifies the more important interrelationships between the independent variables, the regressions can also generate misleading results. Both the benefits and pitfalls can be illustrated by the following purely hypothetical example.

Suppose that more or less concomitantly with the opening up of, say, Muskogee to navigation, a secular decline sets in for a number of the traditional activities which formed the economic base of that community. The decline is, however, offset by new activities attracted to Muskogee by the opening up of water transport possibilities. As a result trends in aggregate employment, population and land values in Muskogee continue at about the same pace as in pre-project years. For simplicity, assume also that the trends for some off-river comparison town also continue unchanged. Since neither the before and after comparison nor the intertown comparison would indicate any change, a naively mechanical interpretation of the comparative data would be that the project has had no effect on land values in Muskogee. Yet to any intelligent qualitative observer of the larger picture it would be evident that the navigational project did have a positive effect.

Multiple regression analysis tries to formalize and quantify this larger picture and could, in principle, capture quantitatively the differential impact of navigational improvements on land values, even when there is no acceleration in the latter. "In principle" means that for it to work in this way the regression model must be well specified--that not only are the main independent variables affecting land values adequately identified and quantified, but also that the analysis is able to adjust for important multicollinearities, i.e., interrelationships between the independent variables.

A multicollinearity problem would exist if, in our hypothetical case, both the declining old and the expanding new activities in Muskogee required common inputs whose growth is sharply constrained. Examples might be a limited amount of level, well-drained industrial site land or a limited pool of local labor available for industrial employment at going wage rates. In this case the rate of decline of the older base activities and the rate of growth of the new activities in Muskogee are likely to be causally interrelated. That is, the initial decline of the older base activities in response to exogenous factors--e.g., a loss of national markets--may have also, by releasing industrial site land, fulfilled a necessary condition for attracting new activities, including those oriented to water navigation. On the other hand, the new activities, by sustaining and perhaps even bidding up wage rates, may have accelerated the decline of the older activities. If these causal interactions are fairly strong, then a multiple regression analysis which does not adjust for them will tend to estimate the impact of the river navigation on Muskogee land values incorrectly (in this example an overestimate).

Other types of multicollinearities might reflect positive intercausality between the independent variables. For example, assume the preceding supply limitations on land and/or labor are unimportant, but that downriver barge shipments of new activities generate very low upriver freight rates (to fill otherwise half empty barges) which, in turn, slows the rate of decline of some of the older industries by enabling them to tap cheaper downriver sources of material inputs. If the effect is important, then a multiple regression analysis which failed to take it into account would give a biased estimate (in this case, too low) of the impact of river navigation on land values.

The main point is that constructing a well-specified multiple regression model is an involved and economically sophisticated task, requiring a good feel not only for which independent variables are likely to have an important impact on land values, but also for which interrelationships between the "independent" variables are likely to affect the regression coefficients strongly. We emphasize "feel" because, while there are formal statistical techniques for detecting the existence of multicollinearities, a good deal depends on judgment derived from detailed knowledge of the technology and economics of the area's various activities. There is no simple predesigned model for this purpose into which data can simply be poured and results churned out.

While multiregression analysis should be included, we believe, in the land value impact study, there are compelling reasons for postponing that phase for perhaps three or four years and concentrating initially on data collecting guided by the cruder but less demanding comparative method.

First, a better analytic "feel" for likely interrelationships should be possible after a few years, when the volume of river traffic may have begun to be important and the technical and economic characteristics of the new activities locating in the river communities becomes more ascertainable.

Second, statistics from other facets of the overall impact study will by then ease the onerous task of measuring the independent variables of the regressions.

Finally, the land value series constructed for the comparative approach would by then also facilitate pilot testing a multiple regression analysis for one or two of the towns for which such series will have been constructed.

Pilot testing on one or two smaller river communities would be a minimum risk way of experimenting with multiple regression analysis to determine its feasibility for use on larger, more complex centers like Little Rock, Fort Smith and Tulsa. The CE might, therefore, consider undertaking such a pilot effort a few years from now.

Some more specific procedures for the comparison method

The selection of sampling areas and starting dates for the land value series should begin as soon as possible. The completion of navigational improvements has taken place in successive economically viable stretches from the mouth of the river upstream to the Verdigris and Catoosa. Corresponding to the successive completion dates is a parallel succession of dates when land acquisition and construction was initiated on each stretch. The following appear to be meaningful subdivisions:

a. From the Mississippi to Little Rock

b. From Little Rock to Russellville

c. From Russellville to Fort Smith

d. From Fort Smith to Muskogee

e. From Muskogee to Catoosa

For each of these areas, the time series should begin prior to the year when landowners and potential beneficiaries from the navigational improvements might have begun to expect an increase in activity and in the price of land along the river. This date is deemed to be 1945, since in the following year the full multi-purpose project was authorized--an event which, in the popular mind if not to the more politically sophisticated, seemed to make the long-debated development a "sure thing."

It is our recommendation that the time series be established as follows: data should be collected for 1944, since this year is prior to authorization of the complete project and valuable land value information at the county level is available for the quinquennial Census of Agriculture of that year. To the extent possible, these data should then be replicated for the single years 1949 and 1954, again utilizing the Census of Agriculture as a mainstay. Beginning with 1959, data should be collected on an annual basis, picking up the considerable data enrichment available from the 1959 agricultural Census--the earliest year for which these data are still available _at the township level_. Prices should be adjusted and the entire series expressed in constant dollars. It is anticipated that, starting with 1979, collection can proceed at five year intervals.

As we have noted, a particular problem of data collection on land values within the region is the low turnover rate, the paucity of recorded land transactions from which to derive useable information. It is recognized that the initial impact of the ARDP in this area will be found to have been an intensification of this scarcity: that is, landowners sensitive to the potential appreciation in value of their holdings would be first and most likely simply to withhold their land from the market, waiting for this potential increase to become actual. How stringently this impulse will be found to have restricted turnover within the sample areas, and hence the possibility of adequate data collection, can only be discovered in the process of research itself. In any event, this factor would not have been operative to any degree in 1944. At the very least, then--even if it proves impossible to derive any meaningful data for a considerable period thereafter--the series can begin with a single baseline year of pre-project experience.

The choice of data collecting sites within each area

Readily accessible sources of data on property values are the quinquennial U.S. Censuses of Agriculture, the sample appraisals made by state assessment equalization committees, and site land prices from the files of various industrial promotion agencies. Many of these data are grouped by county but can be broken down into smaller subdivisions. Their nature and limitations are discussed below, but their main virtue is that they can probably be used to make rough comparisons between land value trends of areas bordering the river and those lying further inland, and that they can be obtained and processed at low financial and manpower cost. They might thus serve as checks on the representativeness of land value series constructed from site sample collecting as well as providing information on the wider impact of the river basin project on property prices.

The main effort, however, should be devoted to collecting data from sample sites within each river stretch and from comparison sites off the river. There are two sets of sites along the river to choose from.

a. All river towns and cities with port facilities excluding, for reasons indicated above, Little Rock and Fort Smith.

b. Potential port and industrial sites along the river in currently rural areas, as identified by engineering surveys: e.g., Carver

& Garver survey for Arkansas stretches and the Richard Bigda survey for Oklahoma stretches.

Using aerial survey maps, a ring approximately five miles in radius should be drawn around the outer edge of the built-up area of each selected town. The ring would probably cover an area of from 110 to 140 square miles, depending on the size of the town, from which to collect land price information. For potential port and industrialized sites currently situated in rural areas, a circle of five-mile radius from the site (about 80 square miles) should be drawn from which to collect land price information. The suggested area sizes are large enough to permit estimation of land price gradients within each area between the river and the interstate highway. For Tulsa and the port of Catoosa, the proximity of the port to the northwest boundary of built-up Tulsa would probably require some adjustment of the shape of the data collecting site to exclude currently built-up urban land.

Each river town selected should be paired with an off-river town of similar characteristics. The similarity can, of course, be only approximate. Essentially the towns should be near each other in size and have had similar population growth rates in the decade preceding the initiation of project construction. Since the river towns are on mainline railroads and an interstate, so the off-river comparison town should have easy access to a railroad and an interstate. The towns should also be in the same general subregion of the respective state; as nearly as possible. The Tulsa-Catoosa comparison should be, as indicated, with a similar sized non-urbanized area in the southwest quadrant of the Tulsa SMSA.

Not all potential sites need be used for data collecting, but it would be desirable to obtain separate land value series for each of the river stretches. Thus the minimum number of utilized sites should include at least one river town and its matching off-river partner in each stretch, for a total of ten. In addition, it would be desirable also to get a sampling of land price trends around at least one potential port and/or industrial site in each stretch of the river, which is not now in or near an urbanized area. Some of these sites, however, are located in rural counties where the annual recorded property sales for the entire county may average below 125 transactions. In order, therefore, to get enough observations for a trustworthy land price index for the potential sites, it would be necessary, initially at least, to combine data from a number of such sites in each stretch. In general, experimental field surveys of average property turnover at the sites will be required before fixing on a determinate number of such site groupings. The experimentation will also help fix more precisely the manpower requirements per given scope of data collecting, for which some rough estimates are presented below.

Ideally, in view of the long time horizon projected for the research--and assuming adequacy of available data--comparison series should be run on nearby port sites in previously undeveloped stretches of the river, one of which does indeed become a port while the other does not. Apart from the long-term nature of the study, this presents in fact the simplest solution to the problem of finding matching sample areas, as well as the most ideal for precise measurement of the impact of the navigational features of land values. It is already apparent, or will soon be, which of the relatively rural sites are to be developed; and where development is underway it precludes, in all probability, development at the next similarly rural site upriver or downriver. Because of their nearness, the two sites can be assumed to share the same general characteristics and the same history of non-ARDP impacts on value trends. As designated "potential port sites," present land values can be assumed to be similarly inflated at both sites. When, over time, it becomes clear that the one site will remain undeveloped (and assuming no other kind of industrial development), the sheer difference in adjusted value of land between the two areas would give a clear index of the navigational impact. The problem of factoring out navigational impact would not exist since, again, the two areas would have been simultaneously subject to the same non-ARDP influences.

Data collection procedures

The raw data for constructing land value series are the recorded warranty deeds of sales. While these deeds often do not state the price of the property sold, that price can usually be approximated from the revenue stamps that must be affixed to the deed, one stamp for each $500 of property value. Until 1967 revenue stamps were required by federal law. With the repeal of the law, the states took over with their own revenue stamp requirements. However, while Oklahoma stepped in promptly, so that there was no break in the revenue stamp requirement for that state, Arkansas delayed passage of its act until 1969. Moreover, in June 1970 the particular form of the Arkansas act was declared unconstitutional by that state's supreme court, although it is likely, we are told, that the law will be reinstituted with the necessary modifications in the 1970 legislative session, since the revenue from the sale of these stamps is badly needed. However, it will be desirable in any event to use supplemental sources of land price information to check prices computed from revenue stamps, since despite the revenue stamps, information from them in many of the deeds of sale are too unreliable to incorporate directly in land price series. There are a number of reasons for this.

First, some of the sales will not be "arm's length" but may be between family members, or may be made in exchange for often obscured considerations. Such sales can usually be identified because ratio of the value recorded by the revenue stamps to the assessed value of the property will deviate sharply from the average assessment/market value for property in the area, or the stamp value will deviate sharply from the sales price of similar type property. Also, some of the added considerations, such as the adoption of an outstanding mortgage, will be stated in the deed of sale. In this case the unpaid value of the mortgage assumed should be added to the sale price. In other cases, the deviation may reflect improvements on the property since its last assessment, or may simply represent the bidding up of property values in anticipation of some higher-yielding use.

Tax deeds and sales involving government should be excluded from the sample, since the prices involved may also deviate from prevailing market values. Many property value studies have been based on prices computed from revenue stamps alone, after discarding transactions with the complications noted above, but experts are not agreed on the reliability of such computed prices. Apart from these complications, there is also the problem of separating out the value of the land proper from the value of the total transaction, which usually includes structures and other improvements.

Because of these complications it will be necessary to check warranty deed data against information from supplemental sources. Two sets of sources are relevant. First, the transaction price should be checked where possible with either the buyer, seller or the broker handling the transaction. This should not be difficult for most recent transactions. It may not be possible, however, for many of the earlier transactions which are needed to establish pre-project land values. In those cases, the transaction price will perforce have to be estimated from the revenue stamps, and the investigator will have to judge which transactions to exclude because of unexplained deviations from yardstick value ratios.

To factor out land prices proper from improvements, the ratio between land value and the value of improvements on the property, obtained from one of the following sources, should be applied to the overall transaction price:

a. From a property tax assessment made close to the date of sale.

b. From the appraisal report related to the transaction.

c. If (a) is not up-to-date and (b) is not available, then it may be necessary to do an on-spot appraisal.

d. Obviously neither (c) nor in many cases, (b) can be used for noncurrent transactions.

Initially, at least, the suggested data collecting areas are mainly rural. It will thus be possible to economize on man-hours with little loss of information by excluding all transactions of under 10 acres from the sampling. Should, however, substantial urbanization and subdivision occur subsequently, it may then be necessary to lower the minimum cut-off acreage. For each observation, the data sheet for recording the relevant information should also include the specific location of the parcel within the sampling area so that changes in the land price gradient over time within the sampling areas can be estimated.

The construction of a land value time series should be undertaken in each area to be sampled. For reliability, the series ought to be constructed from at least 30 verified and usable transactions for each year, although some compromising might prove necessary for the earlier years, i.e., those preceding construction. Studies based on warranty deeds and revenue stamp information alone have usually had to discard about 50% of the annual recorded sales to obtain a core of usable transactions. However, with supplemental sources of information on thesales, the percentage of discards should be smaller.[1]

Another problem is that in any given year land may be sold at widely varying prices per acre within the sampling area. Explicit weighting of sales by their relative importance (e.g., value of the land in a given transaction as a proportion of the total value of land sold in all verified transactions) will reduce some of the deviations of the land price index from the "true" underlying trend of land prices because of changes in the mix of high and low priced parcels. Using the geometric mean would also reduce the influence on the computed average of the extremes of each year's range of land prices. The basic index would, however, probably have to be of the form,

$$\frac{\sqrt[n]{\prod_{i=1}^{n} w_{i1}\, p_{i1}}}{\sqrt[k]{\prod_{i=1}^{k} w_{io}\, p_{io}}}$$

[1]Illustrative is a study by W. M. and J. K. Mann, "Analysis of the Influence of the Pearl River Reservoirs on Land Prices in the Area" The Appraisal Journal, January 1968. In this study discarding took place in two stages. The first, based on examination of the warranty deeds, excluded transactions under 7 acres and non-arms-length sales. However, of the 300 transactions covering a ten year period that were retained, sales price confirmation and the separation of land value from improvements could be made through appraisal reports and other supplemental sources on 277 of the transactions.

This means that year-to-year changes in the index will still reflect both changes in the prices of land sold, p_{it}/p_{it-1}, and changes in the weights, w_{it}/w_{it-1}. Initially, at least, it does not seem possible to devise a reliable set of fixed weights to reduce this ambiguity, since the turnover of land in the sampling area will vary from year to year, and probably will increase, ($n > k$) but in a not yet predictable pattern, and since the size distribution of the parcels sold will also vary and the average size will fall, but also in a not yet predictable pattern. However, as such patterns emerge in time it should be easy to recompute indices with fixed weighting schemes from the collected data.

For comparing trends of river land prices with offriver land, no deflating for overall changes in the prices of goods and services would be required. For before-and-after changes in the sampling area proper, on the other hand, deflating by an available state-wide price index would, of course, be necessary.

The study can be divided into two phases: 1) Aerial mapping of the sample areas and the constructing of land value series from the starting date to the present. 2) Keeping the series up-to-date. The CE, we understand, has complete aerial maps of the Arkansas Basin area. Additional aerial mapping would, therefore, be needed only for the off-basin comparison towns chosen. Apart from aerial mapping, most of the manpower requirements in each phase would be for field data collecting, since sorting, computing and storing the data is simple and computerizable.

Three sets of data--which can usefully supplement the main analysis are available--the U.S. agricultural censuses, state assessment equalization boards, and local and regional economic development agencies. Each has various limitations, but being rather easily and cheaply obtainable, trends derived from these data could serve to supplement those obtained from the direct data collecting effort.

For at least three general reasons the navigation project should stimulate increases in the price of farmland near the river. First, more intensive farming should become profitable under the stimulus of growing river towns and cities, and, in the case of some crops, because of the cheapening of bulk long-distance transport rates. Other things equal, the intensification of agriculture and the rise of land prices should be greater the closer the land is to the growing urban centers; but since "other things" rarely are equal, this gradient pattern is likely to be twisted by various complications--differences in terrain, fertility, nearness to high-speed roads, etc. The regularity of the gradient, however, may be improved by a second factor, namely, that the value of farmland close to the expanding urban centers is likely to be bid up further in anticipation of possible future nonagricultural uses--housing developments, golf courses, shopping centers, etc. Thirdly, the elimination of flood damage, and the creation of recreational lakes along some sections of the waterway should also promote a rise in the price of farmland adjoining the river. Since, except near the river's mouth, almost all of the important urban settlements of each county of Arkansas and eastern Oklahoma that abuts on the Arkansas river, are located very near the river, one would expect the mutually reinforcing effects of all these factors to generate at least the following rough equivalent of a land price gradient. In each county the price of farmland in the townships on or near the river should show a greater upward trend than the prices of farmland of townships further inland.

The problem is to get the farmland price data cheaply and easily. The most comprehensive, easily accessible source of data on U.S. farming, the quinquennial U.S. Census of Agriculture, contains estimates of the value of farm real property (land and buildings) per acre. These data are published on a county level. The U. S. Bureau of the Census will, however, for a moderate price to cover retrieval costs, supply data disaggregated to the township level. The Census questionnaires do not, however, ask for separate estimates for land and buildings. Such a separation could at best be made only through rather intricate and speculative econometric detective work. Fortunately, it is possible to get value of output per farm and per acre from the Census, and hence to compute ratios of the value of farm property to farm output by townships. A persistent rise in this ratio is probably a reasonable proxy for a rise in the ratio of the value of land to the value of output, since it is unlikely that farmers would find it profitable to increase their investment in buildings on land of declining value. Thus, as long as the trend in the value of output per acre is upward, the ratio of the value of farm property to farm output obtained from the Census could probably be safely used as a rough measure of the trend in land values, at least for on- and off-river comparisons by township.

The information in the Censuses on crops, farm acreage, etc. is based on 100% coverage, whereas the land and buildings market value estimates are obtained from 100% coverage only of all farms of over 1000 acres or with annual sales of over $100,000 plus a 20% stratified sample of the remaining farms. The values are essentially self-estimates by the farmer, with two adjustments. First, the Census enumerator may on the basis of assessment ratios and some knowledge of local conditions spot apparent discrepancies and request a revised estimate from the farmer. Secondly, in processing the field data, the Bureau of the Census excludes extreme deviations.[1] In general, according to a conversation with Mr. J. Thomas Breen, Director of Agricultural Division, Bureau of the Census, the bias in the property value figures is likely to be downward, the farmers having a tendency to poormouth. It should also be noted that the 1969 Census dispensed with direct enumerators, using only a mail questionnaire, plus spot follow-ups, so that adjustments in the estimates due to prodding from the enumerator was less pervasive.

The cards and tapes from which township data can be retrieved are discarded by the Bureau of the Census approximately 10 years from the date of initial processing. According to Mr. Breen, the 1959 data is still being kept, but will be disposed of within a year unless the CE were to request a delay in anticipation of a retrieval request. Thus an early decision will have to be made on whether to engage in the collecting of farm land values as part of the land value impact study.

A purely unofficial estimate by Mr. Breen of the cost of retrieving township averages from the Census cards and tapes still extant are:

1959 data \$100 per county

1964 data \$ 50 per county

1969 data \$100 per county

The higher cost for 1959 and 1969 reflects, according to Mr. Breen, the greater retrieval difficulty because of special characteristics of the questionnaires and the record keeping.

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[1]See Appendix A of the U.S. Census of Agriculture for a more detailed description.

It should also be noted that the reliability of the sample averages of property values drops with the decline in the number of observations in the sample. With 100 observations, according to Census Bureau's calculations, the probable sampling error is around 20%. Since townships will usually have considerably fewer than 100 observations of farm property values, it will probably not be possible to go beyond comparing clusters of townships in each county. It should be possible, however, to compare a number of different township combinations in the majority of the counties. The exceptions seem to be thinly farmed Ozark counties, like Perry in Arkansas, for which the 1964 Census recorded only 470 commercial farms. Two or more such counties may have to be grouped for the river-nonriver township comparisons.

One final note, namely that the Census of Agriculture is a rich repository of socio-economic statistics on the size distribution of farms, type of equipment, range of crops and livestock, land tenure, farm employment, land use, etc. While this section of the report deals with land values, it would be remiss not to point out that the full range of Census information disaggregated to the township level would provide the basis for a very detailed and comprehensive analysis of the changes occurring over time in Arkansas Basin agriculture, including econometric analysis to assess the contribution of the river project to these changes. We did not get cost estimates for the cost of full data retrieval by township. But even if the cost per census for the entire 21 counties in the basin were as much as five to six times higher than the $1050 to $2100 required for retrieving farm property and output values, the outlay might well be worthwhile.

State Equalization Board estimates are another existing source of data which could supplement surveys. Currently, only Arkansas has an active state equalization of property assessment program with annual standardized sample appraisals that can be used as a possible supplementary source of land values. Oklahoma is apparently moving toward such a program, but is still in the initial stage of attempting to get a 100% base assessment of all real property by county. Thus the following observations presently are relevant only to Arkansas.

In Arkansas under Act 153 of 1955 a 100% base appraisal of all real property by county was completed some years ago. Acts 234 of 1957 and 244-45 of 1959 then required each county to maintain an assessment ratio of 20% of market value with a maximum allowable deviation of 2%, and required the Arkansas Public Service Commission to police county compliance by annually appraising a 3% sample of all real property in each county. The appraisals are done by the professional staff of the State Assessment Coordinating Committee of the Public Service Commission.

The 3% sample is stratified into rural, industrial, commercial and urban residential categories. Utility and mining property is excluded from the sample, since they are appraised by separate divisions of the Public Service Commission. Half of each year's sample in each category consists of new items randomly selected from all property on the rolls, the other half of each year's sample being repeats from the past year's sample.

The appraisal data are combined into county averages by the Commission and also into school district averages by the State Education Department. The individual appraisal sheets separately value land, buildings, equipment, etc. but the averages are only for the composite property. Unfortunately too, the individual reports are disposed of after about a year. If initiated this year, the land value series constructed from these sample data could only date back to 1969 or 1970. Such series could, however, be put together with relatively little effort from the individual appraisal reports for various county subdivisions, including the sampling areas proposed earlier, the only constraint being that the area be large enough to include an average of at least 30 annual items. In particular, they provide a readily available data source for constructing urban land value series.

Such series are likely to lag behind series based on market sales in those areas where major improvements (e.g., an interstate highway or the ARDP) are creating new and more profitable land uses. This is because the standard appraiser methodology is conservative, being based on the most profitable use within the established range of uses in the area for the land and buildings being appraised. Potential new uses are disregarded until they are actually introduced. The appraisal series could, however, serve as a lower bound check on the market value series determined from special surveys as described earlier. Moreover, despite the lag, series based on appraisal reports will over time reflect economic trends and changing market values and can thus be used for supplemental comparisons of trends in on- and off-river areas.

In attempting to attract industrial and commercial firms industrial promotion agencies collect and feed information to prospective clients on the prevailing price of industrial or commercial site land with various characteristics and locations in the general area covered by the promotional agency. Their files are thus concentrated sources of information for constructing time series on the acre/price of such land in their respective territories. Moreover, the series could be extended backwards into the pre-project past on the basis of earlier recorded sales of such acreage.

Three types of promotional agencies cover the Arkansas Basin area. First there are state-wide industrial promotion agencies, specifically, the Arkansas Industrial Development Commission and the Oklahoma Industrial Development and Parks Commissions. In addition, there are regional economic development commissions, notably the Ozark Regional Development Commission, headquartered in Little Rock, which covers Arkansas west of Dardannelles and eastern Oklahoma the Arkhoma Development Commission, headquartered in Fort Smith, and covering Crawford and Sebastian counties in Arkansas and LeFlore and Sequoyah counties in Oklahoma. Finally, there are local agencies such as the Little Rock Port Authority, the City of Tulsa-Rogers County Port Authority, the Jefferson County Industrial Foundation in Pine Bluff, and the Chambers of Commerce of Little Rock, Fort Smith and Muskogee.

Of the three types of agencies, the state agencies are the least promising source of precise information on land prices since they act mainly as inital contact and referral agencies. However, it would be advisable to explore this more fully with the two agencies than we were able to do. The referrals for more detailed negotiations and assistance are made to the local agencies, and the ones listed above, which are large enough to have competent professional staff, are also likely to have quite specific and detailed information on site land prices in their files obtained for prospective clients. The Ozark Regional Development Commission and Arkhoma, because they service a relatively economically depressed region with towns that largely lack the professional promotional staffs of the above mentioned five cities, have taken on a very active entrepreneurial and negotiating role with prospective industrial and commercial clients. Their files, therefore, are also sources of detailed information on industrial site land in their jurisdictions.

The land values obtained from these sources will probably be derived from relatively infrequent sales. Moreover, in the case of publicly financed industrial parks, the land prices may involve an element of subsidy. At most, such land price series can probably reliably identify only long-term trends. However, the types of activities attracted, the thrust of their inquiries, and their ultimate location--e.g., whether on the channel or near the railroads or the interstate--also provides information on the relative importance of water navigation in attracting these activities as well as shedding some light on trends in land values.

Labor supply and population

As indicated earlier, in the main analysis of economic impacts, there is no rigorous determination of labor supply either in the linear programming analysis of direct effects or in the interindustry analysis of indirect effects. In fact, the implied sequence of analysis would be:

First, to estimate the direct effects, comprising

new or expanded capacity and output in industries sensitive to water transportation rates,

new or expanded capacity and output in establishments

serving the demands of out-of-region users of recreation facilities, and

changes in agricultural or timber output;

Second, to determine the indirect effects on all production activities in the region through an interindustry analysis; and

Third, to adjust those results to take into account the fact that the supply of labor is not infinitely elastic.

Again, as already indicated, there are two ways in which labor supply effects could be taken into account. One would simply use the foregoing analyses as a way of calculating the demand for labor and then, with that information, solve simultaneously for actual employment, population and migration--assuming that the natural rate of increase in population can be specified from observed birth and death rates, and further assuming that the transformation between population and labor force is known (as would be the case, of course, after the fact). The other way of going about the problem is simply to estimate the available labor force independently and use it directly to constrain the solution of direct and indirect effects.

The second approach would seem preferable on the surface, since it is simpler and, after the fact, we certainly would know the population figure. But unfortunately, we do not know what the labor supply would have been in the absence of the project. In short, we need some way of estimating what effect the ARDP has had on the in- (or out-) migration of people.

This poses less of a difficulty than might seem, since the above analyses would take care of determining the extent to which migration would or would not have been effected by the jobs generated by the project, both directly and indirectly.

The techniques of economic analysis already introduced would, then, provide ongoing measurement of ARDP's impact on job related migration flows and labor force characteristics. There remains, however, one kind of population impact which eludes economic analysis: the extent to which migration would be effected by the project's influence on individuals' views of the region as a desirable place to live (apart, that is, from work opportunities).

We do feel that a study of the project's impact on the Arkansas Basin's attractiveness as a place to live should be included in the research design.

This would include the project impact on attractiveness both for people who consider the area as a work place and those who consider it as a retirement location (its appeal as a retirement area is indeed being actively promoted).

However, even though the results of such studies would feed into the evaluation of economic impacts, the studies themselves would involve investigation into people's cultural and life-style preferences more than into purely economic considerations. Accordingly, it seems more useful to consider them under the heading of sociological studies, at least in terms of the kinds of inputs into the research itself, and they will be discussed further in the next subsection of this report.

Other impacts

Another category of direct effects which are likely to occur would stem from increased recreational use. Estimating the indirect impacts of increased recreational use is relatively easy--we can use the input-output indirect impact model already discussed--if we know how much recreational use has developed from the ARDP, how this use is divided by area and residents, and how much is spent in the area on recreation-related activities by each group. Moreover, this information is not very difficult to collect. Essentially it would come from attendance records at recreational sites and spot surveys of recreational users with regard to their place of residence and the amount and composition of their expenditures. One important caution in this regard is to note that what we need to estimate is the net increase in recreational use, not the gross usage at ARDP facilities. In other words, part of the observed increase in recreational use at ARDP facilities may represent a transfer from uses at other existing facilities in the region. Accordingly, this means that we must monitor attendance, residence of users, and recreational expenditures of users at all outdoor recreational facilities not just those in the ARDP. There are many who feel that displacement effects are likely to be small, and they may well be correct. On the other hand, we have no way of knowing that necessarily they will be small and so such monitoring, as outlined above and extending over all recreational facilities should be carried on at least for several years. After that time if displacement use is determined as being small, or if all other facilities are already being used to capacity, surveying could be confined subsequently only to ARDP facilities.

It was indicated above that, after having estimated direct recreation use and expenditures on recreation, the indirect effects could be estimated easily using the input-output analysis. But here again, much as in the case of the estimation of direct impacts on industrial location, we must have categories in the input-output analysis where we can "feed in" the estimates of change in recreation expenditures. It would be most desirable if in the input-output analysis there could be separate activity rows and columns for each major category of recreation expenditure, such as gasoline, other automobile expense, eating and drinking, lodging, recreation equipment, etc. Such disaggregation, however, would be quite costly, and unless very large recreation impacts are seen, especially large impacts by non-area residents, such disaggregation probably is not worthwhile. It should be pointed out that, even without the disaggregation, at least rough estimates of the indirect impact of recreation expenditure could be obtained simply be estimating the value of the recreation users' expenditure at retail and feeding this figure into the input-output analysis simply as a change in final demand for retail goods. Also, even if large, if most of the net increase in recreation use is by area residents, extreme detail and analysis would not seem called for. This is because increases in retail expenditures for recreation by area residents probably would be largely offset by decreases in retail expenditures in other categories by the same residents. In the case of non-area residents, of course, increased spending in the Arkansas River Basin area would be offset not by decreases in that region but by decreases in the region of residence of users.

It is possible, of course, that by switching to retail purchases of recreation commodities and from retail purchases of other commodities, local area residents might be switching from purchases of goods for which there were very large imports to purchases of goods for which imports were much smaller, thus engendering some economic expansion net in the area. In order to investigate this possibility it would be necessary to make an estimate of the nature of this budget shift. This could be done by a sample survey of the budget composition of recreation users compared with a sample survey of other area residents with similar incomes who are not recreation users.

Another kind of direct impact that was discussed earlier was that stemming from a loss of crop land and a loss of timber land due to the construction of the project itself. To obtain the direct economic impacts of these losses it would seem that a single survey could be undertaken. First, such a survey would accurately estimate the number of acres of crop land and timber land removed from productive use. Such estimates do not now seem to exist. After such a survey, estimates would have to be made of how much agricultural or timber production would be lost, essentially by special industry studies. Once these estimates were known, the indirect impacts--in the case of timber and agriculture they would be fairly small, not much more than those coming from the respending of income earned in these activities--could be estimated from the input-output analysis. It should be noted, of course, that here we are talking about solely the economic impacts of the loss of timber and crop land. Environmental aspects of such territorial losses will be discussed elsewhere in the report.

Through most of our research on the project and through most of our discussion with people in CE and others, we have had the impression that the water table was rising in the lower reaches of the river, essentially producing a potential negative impact on agricultural yields. It now seems the case, at least according to CE staff, that various individuals in the Department of Agriculture feel that the water table, if anything, may fall. Clearly it is beyond our expertise to determine whether the water table will change at all and if so in which direction, but clearly this is something which should be monitored at regular intervals and an attempt at estimating its impact on agricultural yields should be made.

One final possible area of impact indicated at the beginning of this section was the enhancement of the Basin as a retirement location. We have already found evidence that the Arkansas River Basin area is attracting retirement residents. No doubt it will continue to do so in the future. On the other hand, while reservoir sites and opportunities for part-time activity and recreation related businesses do offer some incentive for retirement individuals, and while the river facilities might influence the choice of particular retirement locations the extent to which retirement in the area as a whole really would be motivated by the river project itself is somewhat questionable. In any event, it would seem that this could be unraveled only by case studies of retirement families. If after such case studies it was determined that the river project facilities themselves played a real role in such retirement-location decisions, further sample interviewing of retirees could be carried on in the future, otherwise such research could be terminated.

PART IV-B

SOCIOLOGICAL IMPACTS

Except for a statistical comparison of demographic data available from the decennial census, the design of techniques for measuring the impact of the ARDP on social change in the Arkansas basin faces such formidable difficulties that only highly improvisational and largely unquantifiable measure can be recommended.

In this section we shall briefly detail the problems; outline a set of baseline data providing basic demographic and social indicator information; and, finally, propose several kinds of special "case studies" tracing selective indices in which ARDP impact can be assumed to be directly involved. At the outset, and summarizing all of the ensuing, it must be pointed out that really useful application of the proposed techniques to the subject areas can be made only by professional sociologists deeply knowledgeable of the locally relevant social factors. In each of the states there is a single person preeminently qualified to advise on the necessary refinements of these proposals, and the most cogent recommendation we can make is that the research team avail itself, to the extent possible, of their expertise. They are:

Prof. Kent Rice
University of Arkansas
Fayetteville, Ark.

Prof. Brian Kinsey
University of Tulsa
Tulsa, Okla.

The problems of macroanalysis of social change

We face here three kinds of difficulty, the first of which refers generally to the state of the art, to the present research capability of social reporting, while the other two refer to particular problems of measuring social impact of the ARDP.

1. In seeking to assess that part of total social change within the river basin attributable specifically to the project, we are first hampered by the fact that there exists no formal, structural method of analysis for observing total social change itself. In contrast with the long tradition for measuring economic well-being--with such standard indices as mean family income, per capita income, employment levels, output, output per man-hour, etc.--the establishment of indicators of an area's social well-being is a subject of only recent interest in the social sciences. The problem of quantification of social indicator data, and hence of the articulation of a theoretical model by which to measure social well-being, is plagued by the lack of an objective value scale. In social reporting, unlike economic analysis, there exists no overtly standard 0, no 100; the data have relevance only within a value system which, in the first place, is usually highly localized and, in the second place, can be established only by the data themselves.

Efforts have been made to standardize the reporting of social change, as in the following specimen publications:

Raymond A. Bauer (ed.), "Social Indicators," M.I.T. Press, 1966

Center for Urban Studies, Wayne State University. "Social Reporting in Michigan." Detroit and E. Lansing, 1970

They propose the periodic collection of data at macrosocial levels and the manipulation of these data to show trends or changes. Bauer, among others, attempts to specify a theoretical model to guide the manipulation. The most commonly used model is that of "social system," a concept originally developed by sociologist Talcott Parsons, and based on notions of equilibrium. In this kind of analysis, the various parts of the social system are seen as interfunctioning to keep the system operating more or less in accordance with the dominantly accepted value system. Because its framework is an ideal concept of social stasis, the flaw in this kind of model--rendering it particularly inimical to the present investigation--is that it is a poor mechanism for registering social change in general, and especially attitudinal or value changes.

The search for an objective value system in reporting social change has frequently led investigators to relate such change directly to economic development with an evident implicit bias toward the notion that economic growth is a good thing, and always the source of benefits. Historically, it is a product of post-World War II societal affluence, and disenchantment with this kind of model has been swift, since it lacks a way of expressing the costs and disbenefits associated with growth, particularly in the valuational and social spheres. (The cycle of acceptance/rejection of this concept may be seen in the public response to the now classic statement of Charles Wilson: "What's good for General Motors is good for the country.") The past decade in social thought is chiefly remarkable for its increasing awareness of the complex nature of the social effects of economic growth, and certainly part of our task is to make recommendations as to how this kind of concern may be inserted into the continuing assessment program of the ARDP.

In any case, until a great deal more experience in macrosocial data collection has been assimilated, the fact is there are no guidelines for the task at hand, and it would be naive to suggest that we now have sufficient theoretical knowledge of social structures at the scale of the river basin to be able to "trace through" impacts on sociological factors in any formal analytical way.

2. The second difficulty we encounter derives from the terms of our specific task but is related to the valuational ambiguity which lies at the core

of the general problem of social reporting considered above. It is the difficulty of deriving truly meaningful data of social change _per se_. In a study of change where the change is almost solely derived from economic variables, social change cannot be purely measured. That is, to the extent that it can be measured at all it is a component of the economic change. It does not occur in absolute terms: it is an _affect_, or a condition of the economic change and has real meaning only in the economic context. Thus, for example, it would be possible to determine, in sample areas, how many sharecropper families, still _in situ_ after x number of years, had become fully or partially dependent on income from manufacturing employment. This is certainly social change, and it has been measured. But the figures have no objective meaning in themselves: they do not represent a value figure. To refer back, one can extract a value by making, for example, a comparison of the families' income before and after the change in their social condition--but that, of course, is an economic change.

In the impact region, we are dealing with massive social change--the rapid and extensive urbanization of a largely rural population--which is a response to a major shift in the economic base, and in this process the ARDP figures as a factor of intensification. The import of this for sociological research is that it forces the investigation into areas of essentially non quantifiable change--attitudinal, aspirational, institutional. Essentially, the kind of change we must research is that which occurs in the value system itself.

3. Given the generally nonstatistical approach defined above, our research design is very seriously complicated by the fact that baseline information for these elusive and highly subjective factors has been, for the most part, lost. The macrosocial change has been underway for two decades; and for the past ten

years the ARDP itself, as the most extensive "new" economic factor merely by reason of its construction and the advancing reach of its navigational features, has steadily registered its effect on the aspirations and social attitudes of the population. At this point, it is possible to take a reading of what has resulted, but to what extent this represents change can only be inferred.

For the several reasons discussed above, our recommendation is that a basic set of socio-economic indicator data be collected for what it can tell us about total macrosocial change, but that specific and highly refined studies be undertaken, using this material as background and dealing with the processes of change itself and particularly of valuational change. These recommendations are discussed in the following sections.

<u>The collection of macrosocial indicator data</u>

We propose, as the first step for investigation of social impact, that data in the categories outlined below be collected for all of the counties of the impact region in the two states. Since much of the information is available only from the decennial census, the baseline year must be established at 1960; whatever of these data can be replicated for 1965 should be obtained, with complete replication again at 1970. The ten year interval is, of course, a handicap in measuring change which is occurring very swiftly, and it is felt the research team should seriously investigate possibility of sharing costs of a special census at the five year midway point with interested state agencies and the Ozarks Regional Commission. It is anticipated that the 1975 special census would be only a partial enumeration and that participating agencies would be interested in other counties as well. But given the long lead time, the possibility is worth exploring, since the collection of relevant data only at ten year intervals frequently conceals significant reversals of trend. Failing in this effort, or perhaps even supplemental to it, a thin sampling of particular factors which appear to be of special significance could be made at yearly intervals.

The demographic information obtained from these data can be factored for ARDP impact by cross-reference to the economic model. But, as noted in the economic section, it will need to be supplemented with special analysis in reference to determining those who have migrated into the impact region out of preference for the physical environment created by the project. This would consist largely of people who were influenced by recreational facilities directly, or indirectly by the establishment of retirement community or development enterprises related to the river facilities. We are skeptical in regard to motivational research into the decisions of retiree locators, since it would be difficult, expensive and yielding of unrewardingly small results. Instead, we would suggest a simple comparative analysis of the location of retirees and the development of retirement communities in the river region counties of Oklahoma and Arkansas compared with trends of the same phenomena in other counties of the two states. Essentially, the analytical framework could parallel that already suggested in a comparative analysis of changes in land values, as described earlier.

Five year intervals would seem appropriate for periodic monitoring of retirement communities, with 1965 (when all of the major reservoirs were completed) as the baseline year. Calculation of other inmigrating retirees would have to be derived from census data, with 1960 as the baseline.

Motivational research cannot be avoided, however, in determining the extent of inmigration of employed persons in response to project related environmental amenities. It seems most likely that employment opportunities alone will account for a preponderance of inmigration to the region, but this cannot be assumed without a check to determine actual motivation. For this determination, we propose a small sample survey of highly skilled craftsmen, foremen and managerial personnel in selected new or expanding industrial plants located in the impact counties of the two states. These employment classifications are generally considered to have more mobility and a wider range of options than other classifications, and it is these who are enticed with descriptions of the area's amenities in recruitment programs of industry. It is recommended that replication surveys every five years be conducted at the same group of plants, if possible, data being collected only from personnel hired within the interval (as the best means of measuring the cumulative impact). Questionnaires should determine whether the individual had other employment opportunities, conferring roughly the same benefits, at the time he accepted the position; and if so, what determined him to locate in the Arkansas river region. A similar survey should probably be conducted among inmigrant professionals in the cities of the river region. Clearly, one could not extrapolate from the findings of such sample surveys beyond the same classifications of employed inmigrants.

The collected social indicator data will again prove useful, at a macro-social level, for gross estimation of project impact. Knowing something about how total economic change is divided between that due to the ARDP and that which could be regarded as independent of it, will give us a very rough order of magnitude estimate as to how much of the social change might be attributable to the ARDP. In addition, knowing something about the nature of the economic and demographic changes that were due to the project should enable some judgemental analysis of what aspects of observed social change were especially influenced by the project.

This latter consideration leads directly to the most important reason for maintaining this data collection effort. It should be viewed as a source of ideas and problems for specialized studies, as well as a source of indispensable baseline data for such studies. This is why it is important to make the indicator accounting as broad as possible: it should be adequate to backstop most types of foreseeable special studies that may be developed.

Finally, it may be hoped that, after several replications of the social indicator data will have been gathered, the art of social reporting may itself have advanced to a stage where full-scale analytical models will have been articulated. Again, this is reason for casting the data net very broadly, and alone would justify inclusion of the "life-quality" categories included here.

One last word on sources: in addition to census reports, existing resources include the continuing baseline type studies, with much of their data on computer tape, in process at the state universities, the Oklahoma Economic Development Foundation, the Arkansas Planning Commission, and other agencies affiliated with these groups.

The specific data categories should include the following:

A. STANDARD CATEGORIES

1. <u>Demographic</u>

a) Resident population: age, sex, race.

b) Nonresident population (of particular importance if labor needs require in-migration.)

c) In-migration (i.e., "nonresidents" ascertained to be attracted by economic growth, to extent possible. Labor force survey data may be adaptable to this purpose).

d) Out-migration: by race, sex, age; rural or urban origin; educational level; occupation, if possible (existing studies should be continued--see Part III, Cultural Profiles).

e) Nuclear Family: number; average size; household data; divorce; sex of head of household; number of children.

2. Health

a) Births; deaths; infant mortality rate.

b) Morbidity (i.e., disease rates).

c) Disability (with special reference to industrial accidents, automobile accidents).

d) Mental Illness.

e) Health Care Facilities: number of doctors, hospitals, clinics--data where available.

(Health data are important because of the alleged poor health conditions of rural areas; because increasing industrialization urbanization should have a noticeable effect on upgrading health conditions; and because of the undeveloped state of health care services in Arkansas, especially, though both states have problems).

(It should be noted also that present methods of collecting health data have not adapted to changing concepts of health and disease, particularly in the context of ecological matters. E.g., if, as now seems probable, air pollution lies in the background of a number of respiratory ailments, or cancer, health statistics should be collected so as to reflect the increasing importance of these etiological factors. Clearly, the Life Quality indicators need to be geared into the Health data.)

3. Economic (includes labor force, occupations)

Mainly these are dictated by economic impact considerations, but there are some proposals based on sociological analysis:

a) Following the lead of a number of existing proposals for social accounting, we propose a Self-Support Index, consisting of such factors as: number of families by size and composition in self-support; number of families unable to support selves due to various factors; number of families or individuals receiving various forms of assistance; participation in labor force; and occupation. "Self-support" is not really a data category, but a target of analysis of data derived from economic sources and welfare sources. The importance of this type of index for the ARDP is obvious, in view of the generally depressed but steadily improving economic level of the region. The Index might also be of great value in a specialized study of long-range impact on the "poverty" counties.

b) We also propose the development of an Index of Consumption Quality, to apply to in-migrants to the cities from rural areas and to give expression, in terms of purchasing potential, to the loss of those elements of rural life of which these in-migrants feel deprived in their new enviornment--at least, to such of those elements which can be given dollar value expression. That is, surveys have established that although the income level of these in-migrants may be raised, their purchasing power is reduced in terms of certain living standards which are significant to them--e.g., a neighborhood of single family dwellings, the availability of fresh garden produce, etc. Since these elements can be purchased in the city, but at premium price, it should be possible to quantify this loss of consumption quality by equating actual income with income needed to replace an accustomed living standard. Over time, it would be expected that the extent of loss would decrease with a decrease in the sense of deprivation--that is, with acculturation to the exigencies of urban life. The point of the proposed Index, of course, is to give economic expression to what is, in fact, a cost of economic growth.

4. Lawful Behavior (we borrow this term from "Social Reporting in Michigan")

The importance of this category is related to increasing urbanization; however, it would be extremely difficult to isolate any unlawful or lawful behavior caused directly by the river development, and interpretation of this type of information must be done with care.

(We refrain from specifying particular types of "crime" for data collection since the state of crime statistics is in flux, to put it mildly. In general, we would recommend a sociological attack on the problem of population growth in communities, large and small, with traditionalized laws, attitudes, and deficient public services, and also assuming that much of the in-migrant population came from rural backgrounds with certain cultural characteristics along the lines sketched in the appropriate section of this report.)

5. Education

a) No. of grades completed, by sex and age of population.

b) Enrollments in primary, secondary, college, and technical training schools.

c) Nos. of primary, secondary, college, and specialized schools.

d) Training programs inaugurated in private industry.

e) Data on standardized achievement tests administered to school populations.

f) Dropout data.

(Clearly, educational data need to be used in conjunction with employment and occupational data to provide indicators of achievement and the value of given levels of education.)

(It is also recommended that special surveys of occupational aspirations be repeated at intervals, on whole populations or on special groups. These tests would not, of course, be part of the trend indicators data collecting operation.)

(Some indicator accounting systems also use special indices to provide more sophisticated measurements. For example, the "Learning Force" concept, which is an accounting of the educational level of the population based on all of the above types of data. Another explores the relationship between "core" and "peripheral" enrollments, the former relating to basic public educational facilities, the latter including public and private training programs of all kind, exposure to mass media with educational potential, etc.)

6. Welfare (see also, Health)

   a) Numbers and kinds of public social welfare programs; numbers of persons served.

   b) Numbers and kinds of private social welfare agencies; numbers of persons served.

   c) Numbers and kinds of children's agencies; numbers served.

   d) Data indicating needs for welfare institutions: re income, consumption patterns, child abuse, broken families, inability to utilize urban infrastructure, availability of certain public facilities such as employment agencies and organizations to handle problems of in-migrant labor.

B. LIFE QUALITY CATEGORIES

1. Ecological

(Specification of natural ecological factors will be discussed later on. However, it should be noted that we refer here not only to the effects on the natural environment produced by the dams and lakes, but also, and at least equally, to the various kinds of pollution created by industry and increasing by urban concentrations.)

(The approach to Ecological Indicators would be based on the notion that the costs or "externalities" of urbanization, industrialization, recreation, and change in agriculture and community settlement patterns have not been adequately accounted, nor have regular attempts been made to assess changing values concerning these matters in the population as a whole, or in its various groups and leadership sectors. Therefore an adequate accounting in the Ecological and other Quality spheres needs more than indicator-type trend data, but a number of specialized studies.)

2. Continuing assessment of environmental values concerning:

   a) Atmospheric and water pollution.

   b) Density related phenomena--e.g., crowding, transportation difficulties, crime, fear, juvenile delinquency, school conditions.

   c) Governmental responsibility for environment.

   d) Satisfaction with level of living.

   e) Aspirations and desires for living level factors.

   (For (d) and (e), especially: housing; transportation; recreation; conveniences generally; cleaner air, water; occupation; income.)

   (Such studies would be done on stratified samples of the total river region population; on specialized "publics" within the region; or in selected "impact areas" as described earlier.)

3. Continuing assessment of available facilities for:

   a) Transportation (personal and occupational).

   b) Housing (number of units by type, condition, age).

   c) Health conditioning--physical fitness programs, facilities.

   d) Recreation programs and facilities, including private organizations.

   e) Retirement facilities and programs for retirees.

   f) Facilities for young people, including privately sponsored programs.

   g) Cultural facilities and programs, public and private, including training opportunities in the arts and handicrafts.

Specialized studies of key problems and processes of change

Based upon the above data collection, and guided by it, we recommend the initiation of a number of studies of key aspects of social change, to be replicated at appropriate intervals and to be undertaken within indicated "impact areas" similar to those proposed for the study of land value change. It is understood that, for these special studies, replication need not be "forever: for most, in fact, it will be found sufficient to recheck certain aspects of the issue just once, at some future date, the objective being to establish whether or not a certain plateau has been reached, or a certain cycle is under way according to hypothesis.

The specimen studies discussed in the following are to be taken only as representative, since certainly it is understood that selection of key variables and processes can only be made by experts with the kind of depth understanding of the areas as those referred to at the beginning of this section and after intensive analysis of the indicator data outlined above. Case studies of causal systems must cope with the key issue in the kind of process illustrated by the ARDP: the dominance of secondary impacts, or more accurately, the existence of complex chains of cause and effect relationships extending through time.[1] It is recognized that exact knowledge of the prime vectors of influence and change is frequently not available at the beginning of an assessment and must often be acquired from trend analysis of the kind of macrosocial data we have outlined above.

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[1]For an annotated bibliography of water resource studies of this type, see: K. P. Wilkinson and R. N. Signh, "Social Science Studies of Water Resources Problems." Water Resources Institute, Mississippi State University, 1968.

Key questions asked in these studies are "Who benefits, Who does not?". Thus, Bailey and Wilkinson[1] found that among the families on a particular watershed undergoing development in Mississippi, only the already well-off (owner operator farmers, town and village businessmen) benefitted from the scheme, while the displaced low income people constituted a future charge against the system, since they could not benefit from the irrigation and other facilities created. This study isolated a key relational system: in effect, waterworks and economic opportunity, were found to be not connected on a one-to-one causal basis, but were connected through the intermediate systems of land tenure, socio-economic stratification, and aggressiveness in taking advantage of new opportunities.

This type of study can become a source of particular data parameters to monitor over a period of time, or at least of key questions to ask of any data being collected. If studies of this type are expected to generate questions to be asked of routine data, then careful study of existing research studies must be made to find suggestive hypotheses and established findings, remembering that what is true for one social setting may not necessarily be true elsewhere.

On the basis of what has been learned thus far, the following factors would seem to be significant for the ARDP, and would provide the basis for case studies:

1. Relationship between new industrial plants and in-migration of workers to site areas.
2. Relationship between facilities required for new industrial plants and port facilities, and the state of services in the communities involved, including social services. Are new plants paying their share? Are social services taking second place to those needed by industry and the

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[1]W. C. Bailey and M. Wilkinson, "Survey of Families in the Yellow Creek Watershed." Institute of Water Resources, Mississippi State University, 1962.

port? Are people aware and concerned, and have their attitudes begun to be influential?

3. Relationships between changing patterns of land use in an area impacted by the ARDP, and the patterns of social status and attitudes of the population affected, including questions of benefit and disbenefit to that population. For example, in an area getting a strong recreational development, what is happening to farming and farmers? What is happening to farm labor? To land values? To prices locally, and the consequent problems of retired rural people? This kind of study would have to interact substantially with that of land values per se discussed above in the section on economic impact.
4. In general, the relationship between benefits/disbenefits and age groups. The rural and small town population is skewed in the direction of the older age groups, yet many of the supposed benefits will affect the younger groups (employment and recreational opportunities, higher incomes, etc.). Casual linkages between specific types of impact and development, and particular age and sex groups, is an important topic in the Arkansas Valley.
5. Is there a connection between the type of industry that locates in a district because of barge transportation facilities and a certain pattern of labor policies? If this is so, what will be the pattern of labor relations in the river region, given in-migration of local rural populations? This kind of process study would be very relevant to interpreting the analysis of changes in the location of industrial capacity.

6. In the areas directly affected by the ARDP, what kinds of individuals and groups are making the decision affecting the facilities and developments associated with the river program? Who is influential?[1]

To carry out studies of this type, it would be necessary to locate a site, relatively small in area, and establish existing connections between the relevant variables. Repeat studies would be made at selected intervals to see if the causal relationships, and outcomes, remained the same. Essentially, it involves using a baseline study to establish a predictive hypothesis.

All studies of this type should attempt routinely to ascertain attitudes of the public toward the phenomena in question, as well as the relationships among the factors.[2]

Another field of inquiry is represented by studies of change processes. Related to the foregoing, but broader in scope, these trend studies attempt to isolate a particular important pattern or problem of change, and trace its progress. A generalized social process associated with developmental change is institutional differentiation--that is, the emergence of separate spheres of purpose and action in social organization. This is an inevitable accompaniment of economic growth and changing administrative arrangements, and it is most noticeable in small, localized communities and social regions undergoing developmental change.

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[1]It is of interest to note that a study of this type has recently been done for the Corps of Engineers: "Influential Identification: Research Methods and Socioeconomic Characteristics," Appendix I, Susquehanna Basin Communication Study, University of Michigan, School of Natural Resources, 1969)(mimeographed).

[2]For studies specifying attitude survey methods, with special significance for the ARDP issues, see: C. M. York, Instruments for Measuring Attitude Toward a Community Water Issue, School of Psychology and Georgia Inst. of Technology, Atlanta, 1969; M. Wachs, Basic Approaches to the Measurement of Community Values, University of Illinois, 1970; and S. Dasgupta, Attitudes of Local Residents Toward Watershed Development, Mississippi State University, Social Science Research Center, Report No. 18, 1967.

As the sociologist conceives of it, institutional differentiation is a neutral process. It needs specification in terms of benefits and liabilities if it is to be evaluated. In our appendix on attitudes in the region (Appendix D), we note that objections to the ARDP do come from conservative leaders in the river region communities who fear change from the old ways. In essence, these people are objecting to institutional differentiation, which threatens diffusion of the power system insofar as it creates new spheres of authority and fragments power. It also produces new activities and opportunities which result in changed lifeways. It requires new linkage mechanisms to permit cooperation between the separated institutional areas. For example, in many of these smaller communities the area of "welfare" is scarcely distinguishable from informal systems of largesse, such as job giving and favor granting. But with economic development and increasing population, welfare becomes a separate and rationalized sphere of polity, requiring changes in the old informal patterns.

Another generalized process is urbanization, a term which groups a number of consequences of increasing concentration of population, including the need for more facilities and services, zoning problems, pollution problems, behavioral order and disorder, transportation, and the like. Research methodologies for study of the sociological aspects of urbanization are well developed and would seem to require no elucidation here.

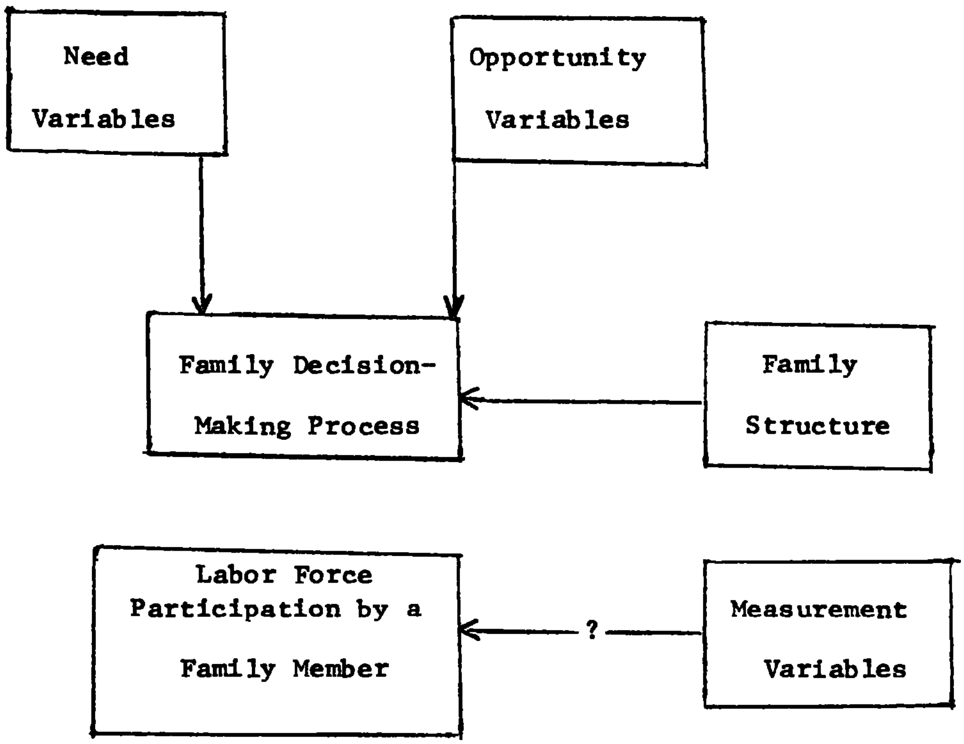
A related process, existing solely at the behavioral level, is urban enculturation. This refers to the learning of new lifeways by rural and small town people after migration into an urban center. We noted earlier the importance of this problem in connection with in-migration to the cities as industry develops. A corollary problem concerns the movement into smaller towns and cities of labor originating in urban areas when these communities share in the development attributable to the ARDP. More generally, a series of processes are associated with the dispersion of population which economic development entails, and these are particularly critical for the Arkansas Valley in view of its substantial non-urban population. These problems will have additional cogency for Arkansas due to its higher Negro population, as compared with the Oklahoma part of the basin.

A more specific process concerns the relationship between changing population density and the costs of services, which characteristically are felt unevenly by different sectors of the population. For example, increasing densities in the Tulsa region will increase costs in some service categories (e.g., education), but decrease them in others (e.g., costs of transport and access to high order urban services). Typically, lower population density results in higher demand for services and higher costs; but the general principle does not always work, since the costs of some services are dependent on factors other than the density variable, and increased density sometimes raises costs if new technological solutions are called for. It is clear that this process will link up with others--urbanization, differentiation, selective advantages for the aged versus the younger members of the population, etc. A small community, enclaved with a developing region but not receiving cost lowering benefits from the development, may be seriously disadvantaged. Expansion of government functions may reduce costs for some communities and groups, but increase them for others.

Another process concerns various phenomena associated with mobility--both geographical and occupational. Certainly the ARDP will affect processes of mobility already under way, as we have indicated elsewhere. Continuing studies of these developments based on the existing models already discussed will be of considerable value. In addition, a theoretical model of decision making affecting occupational and spatial mobility is available in the Sandmeyer and Warner study, and is sketched in Figure IVB-1. This study found that the "family structure" variables were the most important in determining decisions for movement, but the significant intervening variable was "transfer payments"--that is, sources of income other than wages. Where transfer payments were large, inclination to move was low, and the tendency to move back to the country after a brief stay in the city was also marked.

Figure 4 B-1

FRAMEWORK FOR ANALYZING LABOR FORCE PARTICIPATION



Source of figure: R. L. Sandmeyer and L. B. Warner, DETERMINANTS OF LABOR FORCE PARTICIPATION RATES, WITH SPECIAL REFERENCE TO THE OZARK LOW INCOME AREA. Research Foundation, Oklahoma State University, 1968.

Note: "Measurement Variables" concern definitions used in the U.S. census for labor.

PART IV-C

POLITICAL EFFECTS

To design procedures for assessing the impact of the ARDP on the level or nature of political life in the two-state region is, in effect, to "write the book." There is no literature on the investigation of relationships between water resource development and post construction political activity within a developmental region, and obviously the area of study is by nature highly subjective, its parameters largely hypothetical, and its observations for the most part not subject to quantification.

It would, for example, be naive in the extreme to suggest that one could research a certain <u>quantity</u> of political change and then seek to isolate a <u>fraction</u> attributable to impact from the ARDP. The only feasible approach would seem to be to hypothesize certain likely political consequences of this large-scale development, establish the baseline conditions and make periodic checks to determine if the consequences have ensued, and to what degree.

Methodologically, the baseline does not present a particular problem, since it is to be established at 1970, when the project was completed. Once the indicators are selected, data may be presumed to be still readily accessible. The time horizon will, however, be very long, since it must be expected that impact will register itself only slowly and in small increments. For all the kinds of surveys suggested below, it is proposed that replication surveys be made no more frequently than at two year intervals; with experience, three or five year intervals may be found entirely adequate.

With such a multiplicity of highly elusive factors at work, as in the area of political activity, there is only one feasible approach to the problem of factoring out specific ARDP impact. As suggested above, the approach is to select indicators which can reflect those hypothetical consequences expected to result from the ARDP.

In exploring the feasibility of confirming some of these consequences, and testing appropriate indicators, a good bit of actual baseline data are developed. Those data--along with a fuller exposition of the rationale of the approach--are incorporated here as Appendix F, which is recommended to the attention of any with a particular interest in this aspect of the research, and certainly to subsequent researchers working in the area of political impact. In this section, only the outline of the research is presented.

Three aspects of the political complexion of the two states which might be expected to show impact from the ARDP are the regional identity of the states, their respective political cultures, and the degree of activism of their governments as expressed in governmental expenditures. To some extent these facets curve into each other--the third, of course, providing an objective indicator.

Regionalism, however, is the most highly subjective aspect of the political complexion. The literature agrees in placing Arkansas with the group of states identifiable as "the South;" while Oklahoma, as a "Border State", is generally seen as sectionalized. Eastern Oklahoma is identified with "the South," western Oklahoma with "the Southwest," and the middle counties with both, in a mixed identity. Despite the similar affinities the river section of Oklahoma shares with Arkansas, the two are not regarded as a unit in any sense beyond their identification as a river basin. Thus, to whatever extent a regional identity crossing the state borders becomes apparent, it might be regarded as an impact of the ARDP. And evidence of such a regional sense would be yet more apparent becauseit would necessarily run counter to that "Old South" identity which the two now share: that is(blending into the area of political culture), it would be "progressionist" in temper rather than traditionalist.

Attributes of the Old South identity which provide likely indicators of change include: a high degree of centralization in state governments, with relatively minor roles for local governmental entities; a high degree of party control; a low reliance on real property tax, coupled with a level of state government tax effort higher than that in the North; and, compared with the national average, a low score on policy aspects in education, highways and public welfare.

Clearly, a number of these indicators are entirely capable of objective measurement, and Glenn Fisher[1] has developed a way to indicate the cultural influences operative on state expenditures for certain governmental services. Fisher derived estimates of "expected" expenditures based on three independent variables--per capita income, population density, and degree of urbanization. Comparing actual expenditures by any given state with the "expected" levels suggests to what extent they are influenced by factors other than the independent variables. Fisher obtains an overall index of -.74 for Arkansas and of +.65 for Oklahoma, indicating Arkansas expenditures were well below and Oklahoma expenditures well above what one would expect from the independent variables employed. Fisher also showed coefficients for separate policy areas:

	State Institutions of Higher Education	Local Schools	Highways	Public Welfare	Health, Hospitals	General Control
Arkansas	- .3	-1.1	-.7	+ .1	-.1	+.1
Oklahoma	+1.1	+ .2	+.3	+3.2	-.9	-.2

Implications regarding the differing political cultures of the two states would seem to be inherent in these figures: the traditionalist and anti-

[1]Glenn Fisher, "Determinants of State and Local Government Expenditures: A Preliminary Analysis," National Tax Journal, December, 1961.

bureaucratic bias of the Old South--the consensus between public and political elite that government should intervene as little as possible in the private sphere--seems evident in the lower-than-expected Arkansas figures. The Oklahoma figures, on the other hand, seem to reflect the individualist political subculture which looks upon government as a "business", which exchanges votes for services, and which is more ambivalent about bureaucratic aggrandizement. It is interesting here that the greater degree of centralization in state government in the South is reflected in the plus rating of Arkansas for "General Control." ARDP impact would be expected to register in this indicator as a narrowing of the disparity, with most of the shift occurring on the Arkansas side of the ledger.

Other attributes of political culture--e.g., degree of party control, aspects of political "style" (for example, the relative importance of issues and personalities)--are perhaps best researched by studying methods of recruitment to political service and the kinds of people who serve. Since the ARDP is expected to provide inducements for the in-migration of considerable numbers of people from outside the river region, changes in these factors may well be traceable to ARDP impact. The in-migrants, whether laborers, craftsmen, or managers, will be "cosmopolitans," at least relative to the dominant "locals," in that they will have no local affinities and will not share a traditional political culture. In addition, many of the newcomers will have had a wider, as well as a different, political experience and hence may be regarded as "cosmopolitans" in the more usual sense of the word. Finally, having themselves been attracted to the region by a development project, they may be expected to be oriented toward growth and toward programs promoting development, in distinction to the less innovation-prone locals. The research in this area, which is regarded as particularly promising in terms of discovering impact, is unfortunately complicated by the necessity for discovering biographical detail not statistically available: that is, it will frequently involve questionnaires or personal interviews with the individuals involved.

An approach to assessing the "cosmopolitanization" of the region which does not carry this handicap, however, is to collect data at five-year intervals on various categories of governmental spending within the river region, broken down by counties--source for which is the quinquennial Census of Governments. Collected over time, significant differences between counties within and without the river region might well be expected to appear in per capita expenditures for governmental services.

The more direct approach of researching the makeup of administrative and legislative bodies, both appointive and elective, can scarcely proceed without obtaining biographical information, and it is proposed that this be done through questionnaires directed to the bodies themselves. Boards of school districts and levee districts are elective in both states, but other types of special districts are administered by appointed boards. A further rewarding line of investigation would be to learn what impact the newcomers to these bodies may have on the expectations and attitudes of the old-line members: again, what one would expect to find would be a reorientation toward innovation, a change in role from the impartial "administrator" to the partial "advocate," or vice versa. Information of this sort could, of course, only be obtained by in-depth questionnaires or interviews. Periodic surveys of members' views should cover: the proper role of government; how they see their own task; the need for new ideas, for change; the proper postures regarding "administrative" and "political" activities, etc.

An approach not absolutely requiring biographical data would be a long-term study of tenure in the state legislatures, perhaps contrasting river and non-river districts. Entrenchment of locals would be expected to result in longer tenure of these elective offices, whereas cosmopolitanization should produce shorter terms, greater turnover. Anything like a definite trend could scarcely be established, however, in a survey of less than 20 years or more. Data presented in Appendix G for the period 1945-67 (unfortunately, averaged for 1945-63) would suggest that the trend in recent decades has been toward longer tenure in both legislatures. This would provide an excellent baseline for testing the hypothesis. It is proposed that occupational backgrounds of legislators be researched as well as their residence experience and party affiliation. Sources for information of this type, which might considerably reduce the research burden, are cited in Appendix G.

A study of methods of recruitment to elective office offers a corollary approach--again, requiring personal interview. The hypothesis in this case would be that cosmopolitanization would result in a higher degree of self-recruitment, of sponsorship by informal or ad hoc groups, in contradistinction to fairly rigid party recruitment in a political culture dominated by locals.

It is suggested that a study employing in concert as many as possible of the approaches described above in the personnel area of cosmopolitanization would produce a body of correlative data of impressive scope in assessing the degree of political cosmopolitanization attributable to the ARDP.

Two further areas of investigation of ARDP impact suggest themselves. The first is the sophistication of governmental structure in response to new awareness of the need for various types of planning and control. Governmental and quasi-governmental bodies, such as districts for sewage, drainage, water supply, pollution control, environmental control (signs, billboards, architectural design), are examples of structures which may result from the ARDP. There may also occur a process of sophistication in municipal governments--particularly in the division of managerial and planning functions. Data showing a trend to the increase of special districts in both states between 1952 and 1967 are presented in the appendix, and data sources for continuing research are cited.

Finally, and least measureable objectively, are in the area of political style, where one would hypothesize that the ARDP would contribute to, though not in itself wholly produce, a shift away from the spectrum of down-home emotional appeals typical of southern politics to a more issue-oriented kind of campaigning. A content-analysis of political speeches and statements of public officials, perhaps supplemented by an analysis of journalistic treatment and response to these statements, would appear to be the only approach. In this study, at least, it should not be necessary to contrast the findings within the river region to developments outside it: one would expect merely to monitor change, over time, within the region itself.

This last approach to the problem of assessing impact is clearly the most judgmental of the measurements proposed; but there is no evading the fact that the entire area of investigation is one where almost all objectivity must reside in the eye of the beholder. The few indicators which lend themselves to statistical analysis should certainly be carried through, and as many of the more subjective approaches as possible. In tracing one elusive element through so densely opaque a fabric as the political life of a region, the more lines which are tracked the better, for the accumulation of corroborative data assumes central importance.

PART IV-D

ECOLOGICAL IMPACTS

The problem of designing a research program for assessing the impact of the ARDP on the ecology of the Arkansas River itself is in several ways uniquely different from the other areas of this study.

In the first place, for all practical purposes, there are no baseline data available or recoverable, and the central problem of the research design is to find eligible control areas on tributary streams which can provide a surrogate baseline. From the time construction began on the first mainstream reservoir, the river as a natural system began to be diminished, until now--with a navigation channel maintained at a minimum depth of nine feet throughout the length of the basin from the Post Canal to Catoosa--it has entirely ceased to exist. At no time prior to the start of construction were any of the kinds of surveys proposed in this section systematically undertaken by any agency of local, state or national government on a scale or in a manner useful to our present purposes. There is no baseline: and to construct a substitute will prove painful and costly.

In the second place, on the river itself, all assessment of the ecosystem except for water quality represents impact data--barring, of course, such "acts of God" as prolonged drought or flood, the effects of which are themselves drastically modified by the project. The river is not to be seen here as the creature of the project: rather, the river and the project are no longer separable; they are one and the same mechanism.

This was, of course, the exact intent of the project development, and remains so--to control, to reshape to human uses an unruly, unpredictable and largely unloved mainstream--and it is pointless to deplore the loss of an ecosystem the destruction of which was deliberately pursued over a hundred-year history of intense legislative, fiscal and engineering effort. But it is equally pointless to disguise the fact that a survey of the impact of the ARDP on the ecology of the river system must inevitably produce a catalogue of loss, of disbenefits--in short, of costs, most of which are of a nonmonetary nature.

Such a survey can still be produced, and the following sections present a program for carrying it through. The question remains whether so unappealing a study--beset with difficulties and productive mostly of bad news--will be or should be carried forward. In our opinion, it should be given high priority, not simply for its relevance to future developments but, with at least equal importance, for its very large significance to the formulation of public attitudes toward the large question of river development itself and toward the CE as its prime instrument.

It is surely unnecessary to detail here the mounting tide of concern with which the American public views the retention of nonmonetary values in its environment. The specific and localized concern expressed at the loss of habitats now reverberates within a national consensus of concern in which each threatened plot is recognized as an item toward total extinction. It becomes abundantly clear that this generalized public impulse can be effectively rationalized only on a basis of thorough candor, in which nonmonetary costs can be fully weighed. In choosing between widespread economic benefits for a depressed region and the loss of game fish or of wildlife habitats, it is not posited that the public decision in the future would or should be any different from what it has been in the past. What must be different, however, is that the public make the determination with its eyes wide open and in full cognizance of all the relevant facts. At the very least, this implies a considerable sophistication of cost-benefit analysis in such future determinations,[1] and the present section presents an approach to quantifying these largely nonmonetary, ecological costs in terms of diversity of species. To "make the crooked straight and the rough places plain" entails a cost, a diminishing of the variety of life forms, a loss in the brilliance and interest of life itself. What is proposed here is that the extent of this loss can and must be quantified. Its value is then a matter for public determination.

Any natural ecosystem, a result of the evolutionary process, is characterized by one major feature, a relative constancy of diversity among the inhabitants of that ecosystem. This diversity of life forms is possibly the only valid generalization that can be made about an area and is therefore applicable to the variety of biologic environments that are to be considered within the Arkansas River Basin.

While naturally occurring population fluctuations of various life forms will occur both as a result of favorable conditions and conditions of environmental stress, rarely do these conditions result in the total elimination of a particular species. Only when the stress is exacerbated to a degree and within a time span not allowing adaptation by organic evolution, does a narrowing of species diversity occur.

For example, in the area with which we are concerned, there exist many warm-water streams which support various species of fish well adapted to these

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[1]See "A Study of Certain Ecological, Public Health and Economic Consequences of the Use of Inorganic Nitrogen Fertilizer," a research proposal to the National Science Foundation of the Center for the Biology of Natural Systems, Washington University, Dr. Barry Commoner, Dir., pp. 104-121, where an analysis of economic and social costs containing cost-benefit analysis and a discussion of "social exchange" is made. This proposed study is concerned with the Sangamon River in Illinois.

warm waters. When high dams are built on these streams and cold water is discharged during power generation, the fish experience acute environmental stress from the resultant temperature change. The Little Missouri River in Arkansas is an example of what happens when such stress is applied. Here, "ninety miles of barren stream from Narrows Dam to its mouth now exist."[1] Here stress has been acute enough to eliminate not just one species of fish, but <u>all</u> species naturally inhabiting the affected portion of the river.

When a narrowing of diversity does occur, the stability of the ecosystem, which is the result of complex organic interactions, has been disrupted. A reduction of complexity, a simplifying of a particular ecosystem, is a threat then to stability as well as an indicator of environmental stress. Septic conditions are indicated by small numbers of species and large numbers of individuals within the remaining species of organisms.

The kind of stress brought about by a radical change of water temperature is, of course, extreme. Stress is usually more subtly extended. As a result both of this subtlety and original diversity, there is often no awareness of change occurring until weed species (species with wide tolerance of environmental change) have increased in population size at the expense of all others. The total number of organisms might be the same but the diversity that is the determiner of stability has been altered. Often what remains is undesirable and unwanted from a human point of view.

In a study of a small watershed in eastern Pennsylvania, twenty-three species of fish were found to inhabit a mainstem stream which was relatively

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[1]Hulsey, A. H., Chief, Fisheries Division Arkansas Game and Fish Commission, "An Analysis of the Fishery Benefits to be Derived From a Warm-Water Tailwater vs. A Cold-Water Tailwater."

free from pollution. Contrasted to this was a polluted tributary in which only three species, a carp, killifish and creek shiner (three pollution-resistant forms) were identified. The total pounds per acre of fish in the two streams were approximately the same because the three tolerant species were able to survive and reproduce under stress and were free from competition and predation. If environmental stress were added to the mainstem stream, the individuals of the more sensitive species would undergo a change in population size and they would gradually be replaced by what are termed "rough" fish.

"The change is often not obvious even to a trained observer unless he has studied the area sufficiently well over a period of time to have statistically reliable data."[1]

Again, the biomass might be the same, but what is desirable has been replaced. "Since man wants his fish in large size, and not as "sardines," size is a consideration and, for man, aesthetics as well as economics are considered important."[2]

Anyone who has tried to keep a given body of water in a state to his liking, whether it be the size of a tropical fish aquarium, a family swimming pool or a farm pond, learns first-hand, how difficult and expensive it is to maintain a man-made ecosystem. In the area of the Little Missouri River, "tens of thousands of dollars have been expended in an attempt to create some kind of fishing in this stream. To date all of these attempts have failed."[3]

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[1]Cairns, J. Jr., "We're in Hot Water," Scientist and Citizen, Vol. 10, No. 8, October 1960.

[2]Odum, E. P., Fundamentals of Ecology, W. B. Saunders Company, Philadelphia and London, 1959.

[3]Hulsey, op. cit.

Large impoundments present a case in point. Attempts to keep them in a desired state so far as fishery resources are concerned, has proven difficult and so far there is no formula for success.

Nimrod Lake is a reservoir on the Fourche LaFave River in the Ouachita highlands of west-central Arkansas. The original stocking of the lake with smallmouth bass, largemouth bass, and bluegill sunfish produced "the finest fishing ever experienced for some 5 or 6 years."[1] However, nutrients and sediments began to accumulate, eutrophication set in and, as a result of the excessive enrichment and turbidity, carp, shad, buffalo, drum and gar began to replace the desirable fish and after 8 or 9 years, "Nimrod is nothing like the lake it used to be."[2]

Changes had begun to occur in this lake before biologists had an opportunity to study it, and it was difficult for anyone in contact with the lake in a superficial way to notice the changes as they occurred.

Here again, there was no shortage of fish, but the 250 pounds of fish per acre was composed of fish no angler would find desirable.

It would be convenient, for the purpose of the proposed research, if there were established, reliable "indicator" species (species so exquisitely adapted to a particular environment that a change in the population of this species could be used as an accurate indication of impact). Unfortunately, the water quality requirements of most of the "indicator organisms" have been thoroughly investigated, so that specific factors limiting their distribution and abundance

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[1]Mathis, W. P., Assistant Chief, Fisheries, "Nimrod Lake Fishery Management 1942-1967."

[2]Mathis, op. cit.

is not really known. Nor is it known just why any of the so-called clean-water organisms begin to disappear from waters subject to increasing organic enrichment.[1]

Because of the many interacting factors, it is possible for some links in the food chain to be effected without a complete breakdown of the system. Often, only after the higher forms of life have begun to disappear is there an awareness of ecological change. A dramatic example of this sort of response is the crisis response elicited by an endangered species.

There are few, if any, remaining natural environments which have proceeded through time and the necessary seral stages to a climax environment. Therefore the question of control for the research becomes a problem. An additional problem is posed by the increased number of variables that will occur as the result of development within the area.

It is suggested, therefore, that selected, sensitive environments be singled out for surveys to be conducted over a period of time. Such surveys can supply data which will establish the condition of the various areas and will document change as it occurs.

If the environment is to be pleasing aesthetically, if it is to allow for the widest range of recreational usage, and at the same time furnish a food supply and permit disposal of waste products, the environment must be relatively stable. This stability results from the environmental checks and balances of diversity, and from the resiliency inherent in it.

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[1]Doudofoff, P., and C. E. Warren, "Biological Indices of Water Pollution with Special Reference to Fish Populations." Biology of Water Pollution, United States Department of Interior, 1967.

The study proposal which follows is divided into five categories of investigation:

1. Water Quality of the River and Reservoirs
2. Water Quality of the Tributary Streams
3. Bank Vegetation and Wildlife
4. Bottomlands
5. The Recreation Environment

I. Water Quality of the River and Reservoirs

In a study of water quality within the Arkansas River, terms such as "stream health" and "pollution" can be variously interpreted. The word "pollution" has become somewhat of a pejorative term, its definition very much dependent upon the dominant use for which the particular resource is being considered by the interested persons.

Whether the river is viewed as a recreational source, a food source, a recipient of industrial and municipal wastes or simply as something aesthetically pleasing, will determine what forms of disturbance will be viewed as "pollution" and regarded as cause for alarm.

In its report to the Federal Water Pollution Control Administration, the Committee on Water Quality Criteria considers criteria for water usage under five general headings: (1) Recreation and Aesthetics; (2) Public Water Supplies; (3) Fish, Other Aquatic Life and Wildlife; (4) Agriculture and (5) Industry.[1] In the forward to the report, the committee comments upon the lack of adequate

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[1]"Report of the Committee on Water Quality Criteria." Federal Water Pollution Control Administration, United States Department of the Interior, 1968.

knowledge concerning many of the quality characteristics upon which criteria and standards for the above should be based, and concludes that at this point the unknowns still outweigh the knowns.

"Like other characteristics of the basin, water quality varies a great deal."[1] The upstream water quality is satisfactory for varied use since surface water in these reaches is derived largely from snowmelt and rainfall occurring in the Rocky Mountains. However, in addition to the large amounts of industrial and municipal effluents from Hutchinson and Wichita, Kansas and from oil refineries in south central Kansas and north central Oklahoma, minerals are picked up by the river as it flows through a natural salt producing band. Groundwater in the alluvium and terrace deposits along the Arkansas River in north central Oklahoma is of better quality than river water.[2] In Arkansas, tributaries draining the Boston and Ouachita Mountains contribute quantities of good water but the mainstem of the Arkansas River is polluted by sewage from towns along its course and by coal mine drainage. There exists, therefore, a wide variation in the character of the water being affected by the contaminant, and different sections of the river can be differently influenced by, for example, industrial wastes.

In addition to impact on the river from such things as channelization, reduced turbidity, increased minimal flow, alteration of stream bank vegetation and removal of rooted aquatic plants, the already complex problem of water

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[1]Penix, J. R., Remarks at Arkansas-White-Red Basins Seminar of League of Women Voters; Fort Smith, Arkansas, March 17, 1970.

[2]Eley, R. L., "Physiochemical Limnology and Community Metabolism of Keystone Reservoir, Oklahoma." Doctoral Dissertation, Oklahoma State University, Stillwater, Oklahoma, 1967.

quality can be expected to be intensified by many as yet unknown factors. As development proceeds, increased urbanization, industrial growth, barge traffic, etc., can be expected to intensify both the stress and amount of concern for water quality. Not so long ago, if a given body of water was too degraded for a particular usage, the water user simply sought, or was expected to seek, alternate choices. With the new concern for environmental quality, there will no doubt be demands for a speed-up in programs for pollution abatement.

The industrial and municipal use of the river and increased concern for water quality meet head-on and result in more urgent need for determination of the water quality of the river. A great deal of scientific investigation now exists on chemical and biological methods of detecting changes in water quality.[1] As might be expected, chemical and physical methods are more refined and standardized than biological.

Various biological indicators have been suggested.[2] However, biological indices pose several problems in that no single biological indicator can be singled out as recording measurable impact for all of the concerns mentioned above and it is therefore necessary to define what each indicator measures. Does it show, for example, continual presence of dissolved oxygen in certain concentrations believed to be adequate for sensitive fish species? Does it suggest a level of organic enrichment likely to interfere in some way, other than through oxygen depletion, with certain specific uses of water? Or does

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[1]Algae in Water Supplies, United States Department of Health, Education and Welfare, Public Health Service Publication, 657, 1962; and, Biology of Water Pollution, United States Department of the Interior, 1967.

[2]U.S. Department of the Interior, op. cit.

it indicate that particular toxic substances have not recently been present in concentrations likely to be injurious to fish, to man, or to certain crops?[1]

Also, toxicity of water can be greatly influenced by interaction between the toxic agents and dissolved minerals present in widely varying amounts in the receiving water. For instance, the salts of heavy metals are generally more toxic in soft or acid waters than they are in alkaline.[2]

Pollution can occur from a rise in temperature, a change in character of the stream bottom, increased turbidity, change in amounts of dissolved oxygen, an increase in dissolved nutrients, addition of toxic water, etc.

In order to view the river as a biological entity, to know and define impact on the entire life of the river, it is necessary to conduct a survey which considers the total community structure, such as the one done by F. J. Trembley of an area of the Delaware River.[3]

The procedures for a total survey, including selection of testing sites, are presented below. First, however, we must consider the problem of establishing a baseline. Unfortunately, there exist no pristine areas of the Arkansas River which can serve as controls for a study of water quality. On the other hand,

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[1]Doudoroff, P., "Biological Indices of Water Pollution with Special References to Fish Populations," Biology of Water Pollution, United States Department of the Interior, 1967.

[2]Gaufin, A. R., and C. M. Tarzwell, Discussion reprinted from the 25th Annual Meeting of the Federation of Sewage and Industrial Wastes Association Meeting; New York, N.Y., October 6-9, 1952.

[3]Trembley, F. J., "Research Project on Effects of Condenser Discharge Water on Aquatic Life," Institute of Research, Lehigh University, November 1960 and April 1961.

water testing on the river has been unsystematic in the extreme and even where records are recoverable they can provide only a partial and episodic baseline for a total water quality survey. In its 1955 report, the AWR Basins Interagency Committee took note of the random nature of testing in the area:

> The collection of data on chemical quality of surface waters has, for the most part, lagged behind the collection programs for other types of hydrologic data. Scattered samples have been collected over a period of many years but no continuous or systematic program of sampling has been carried on until comparatively recent years. Current programs vary widely from state to state and for many areas are seriously deficient. An inventory of surface water records, compiled by the Water Resources Work Group, contains references to quality of water records which have been collected up to 1950. It includes information on the period of record, frequency of sampling, total number, and most common analytic values reported.[1]

The report noted 4 regular sampling sites on the Arkansas River in Arkansas, and 15 intermittent sites; in Oklahoma it noted 19 regular sites and 33 intermittent. The committee proposed the addition of 5 regular sampling sites in Arkansas and 36 in Oklahoma. It recommended daily sampling at the regular sites, with testing for a wide range of dissolved minerals, as well as dissolved solids, total hardness, non-carbonate hardness, specific conductance, pH, and temperature.

The U.S. Geological Survey has maintained monitoring stations on the Arkansas River since 1941, perhaps earlier, but their published annual data appears to be presently available only from 1964 forward, from:

District Chief, Water Resources Division
U.S. Geological Survey
2301 Federal Office Bldg.
Little Rock, Arkansas 72201

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[1]Arkansas-White-Red Basins Interagency Committee, Report, Part II, Section 15, Hydrologic Data Collection Program, p. 50. 1955.

The Arkansas Pollution Control Commission has maintained three National Water Quality Network monitoring stations since 1957. Annual compilations are available from 1957 to 1962, after which they have been provided as bulk printouts. These are available from:

Federal Water Pollution Control Admin.
Division of Pollution Surveillance
Taft Sanitary Engineering Center
Cincinnati, Ohio

In correspondence with Neil M. Woomer of the Arkansas Pollution Control agency, he states that the volume of data is enormous and that no facilities exist locally for reproduction of ongoing work.

Assuming that data from these various sources is already deposited in CE files, or readily available to the CE, we can only propose that a search of this highly variegated record be made by the research team to determine its adequacy as baseline data--on a highly selective basis, obviously. What is most likely is that it will provide a partial baseline; in that event, where gaps exist, change can be measured only from the date of commencement of data collection for the research.

For reasons which will be explained, it seems unlikely, however, that these data sources will provide the most easily accessible data for the ongoing monitor checks.

It must be emphasized, regarding the following procedures, that although they are presented separately here, equal importance is attached to the species identification and the chemical-bacterial testing. A continuous monitoring of the species diversity index is essential when, as with this research, it is desired to determine trends and to have data for future comparison.

Procedures for water quality testing

I. Sampling stations

A. On the river

1. Outlet of the reservoirs, 1500 feet downstream, 4000 feet downstream.

2. At points of industrial input (pollutants, heating, etc.),directly above the installation, at the input, 1500 feet and 4000 feet downstream from the source.

3. Use the same distances for checking inputs resultant from city sewage.

4. Use the same distances to determine effects from points of heavy farm run-off.

B. Reservoirs

1. Inflow and outflow.

2. In selected backwaters.

3. Selected sites within the body of the reservoirs.

II. Tests

A. Physical

1. Temperature.

2. Flow (Free-drag method of the University of Wisconsin).

3. Turbidity (Jackson Turbidimeter)

4. Total solids (Standard gravimetric procedures)

B. Chemical

1. pH (Beckman pH meters).

2. Alkalinity (Methyl Orange test).

3. Dissolved oxygen (Alsterberg-Azide procedure).

4. CO_2 (Sodium hydroxide titration procedure).

5. Phosphorus[1]

6. Ammonia nitrogen[2]

7. Nitrate nitrogen (Hach Chemical Co. procedure)

8. Chloride ions (Mohr method)

9. Sulphate ions (APHA, 1960)

10. Biochemical oxygen demand (APHA, 1960)

11. Mercury (Use Eastman-Kodak techniques)

12. DDT

C. Biological (Use diversity measure index, page 261-262)

1. Microorganisms (use periphyton)

   Microscope slides kept just below surface for several days. Then check microscopically for

   a. Number of species

   b. Species identity

   c. Distribution of individuals.

2. Macroinvertebrates

   Use Surber stream bottom sampler (Welch). Check as for microorganisms, above.

3. Botanical survey

   Aquatic rooted plants, detailed survey above and below points of interest.

4. Fish survey

   a. Number of species

   b. Identity of species

   c. Distribution of individuals

5. *E coli* tests (APHA)

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[1]See footnote 2, p. 259.

[2]See footnote 2, p. 259.

III. Use of tests

A. Effects of heating water (steam power plants, atomic power plants)

1. Make cross-sectional temperature contour maps of river at the testing stations (Test A-1).
2. Plot maximum and minimum temperatures at a station, monthly (Test A-1).
3. Plot stream flow, monthly (Test A-2).
4. Effects on microorganisms in heated region and amount of recovery downstream (Test C-1, above, made weekly throughout the year).
5. Effects on macroinvertebrates in heated regions and recovery downstream (Test C-2, made monthly throughout the year).
6. Effects on aquatic plants (Test C-3, once a year).
7. Effects on fish (Test C-4, once monthly).

B. Industrial pollutants (mercury, acids, etc.)

1. Keep weekly records of physical and chemical changes (Tests A-4, B-1 through 11).
2. Effects on microorganisms (As above in III-A).
3. Effects on macroinvertebrates (As above in III-A).
4. Effects on aquatic plants (As above in III-A).
5. Effects on fish (As above in III-A).

C. Farm run-off

1. Keep record of physical and chemical changes (Test B-1 through 7, 10, 12)
2. Check effects as above in III-A and B.

D. City sewage

1. Keep weekly records (Tests A-3, 4, B-1 through 4, 10, C-5).
2. Check effects as above.

E. Reservoirs

Reservoirs are project created. Whatever happens to the waters within the ARDP reservoirs, can be attributed to project impact. The reservoirs on the river will cover an area of approximately 100,000 acres and will be expected to provide water for multiple use. Increased stress on these waters will be applied from many sources, yet water quality will need to be maintained in a way that will maximize chemical and biological benefits. Long term comprehensive studies are required on the various reservoirs in the area.

1. At normal pool level, establish morphometric data, total drainage, contributing drainage, surface area, volume, mean depth, maximum depth, development of volume (mean depth-maximum depth).
2. Plot drainage, rainfall, air temperature vs. months. This data can be acquired from the Corps of Engineers and the U.S. Weather Service.
3. Calculate water balance (from data on inflow, precipitation, discharge, evaporation).
4. Keep weekly records of physical and chemical changes. (Test A-1 through A-4, B-1 through B-12).
5. Check effects as above.

Exhaustive though they may appear, it remains a moot question whether the procedures outlined above provide a truly adequate check on the effects of man-originated phosphorus and nitrogen leached from fertilizers. These elements accelerate the eutrophication of lakes and reservoirs, and the tolerances are very narrow. Considering the importance of reservoirs in the ARDP system, a <u>totally</u> total survey should probably include a monthly quantitative analysis of phytoplankton.

The "bloom" check is recommended because neither phosphorus nor nitrogen singly can be predicated as the triggering element, and their interaction varies. Phosphorus is often the limiting factor in plant productivity, and when favorable conditions of sunlight, temperature and transparency are present, phosphorus in excess of a critical concentration (together with an adequate supply of nitrogen and micro-nutrients) will stimulate nuisance blooms of algae and obnoxious growths of rooted aquatic plants.[1] Mackenthun[2] suggests that to prevent biological nuisances, total phosphorus levels are critical at 0.100mg/l for streams and 0.050mg/l for reservoirs.

Nitrogen, on the other hand, quite readily undergoes changes from one form to another and Muller[3] concluded that excessive growths can be avoided if the concentration of nitrate nitrogen is kept below about 0.3mg/l and the concentration of total nitrogen approximately to 0.6mg/l. However, Sawyer[4] in a study of 17 lakes in southern Wisconsin, concluded that concentrations in excess of 0.01mg/l of inorganic phosphorus (P) and 0.30mg/l of inorganic nitrogen (N) at the time of spring overturn could be expected to produce algal blooms of such density as to cause nuisance.

A quantitative analysis of phytoplankton indicates directly whether critical levels have been surpassed. A phytoplankton bloom is marked by large numbers

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[1]Carrick, L.B. and Hall, E. T., 1969. A Water Quality Survey of Jackson Lake Upper Reservoir. Georgia Water Quality Control Board in cooperation with Federal Water Quality Administration, p. 7.

[2]Mackenthun, K. M., 1968. "The Phosphorus Problem." Journal American Water Works Assocation, Vol. 60, No. 9, pp. 1047-1054.

[3]Muller, W., 1953. "Nitrogen Content and Pollution of Streams." Gesundheitsing, Vol. 74, p. 250; Water Pollution Abstracts, Vol. 28, No. 2, Abs. No. 454.

[4]Sawyer, C. N., 1952. "Some New Aspects of Phosphates in Relation to Lake Fertilization." Sewage and Industrial Wastes, Vol. 24, No. 6, pp. 768-776.

of plankters but highly restricted species diversity per unit of the first few centimeters of surface water. Exact criteria for bloom conditions have not been established, but there is close agreement. Lackey[1] considered a bloom to exist when any one organism reached or exceeded 500 per ml of raw water. In a study by the Georgia Water Quality Control Board, when the total algae reached a density of at least 5,000 organisms per ml, with one or more algal genera exceeding 500 organisms per ml, a population density of bloom proportions was considered to exist.

Data collection

All things considered, the best recommendation for collecting data would seem to be for the ARDP research team to originate the data. A total water quality survey of the entire river below Catoosa, plus the reservoirs and tributaries, can scarcely be carried forward in any case without a permanent research staff. A majority of the physical and chemical tests (DO, BOD, pH, temperature, total solids) can be performed by one person almost as quickly as he can drive between stations: these are the tests most likely to be done by the existing monitoring stations, to be sure, but sorting out the desirable data is time-consuming, and certainly not all of the check-points required by ARDP's research needs would be covered. The biological tests are more complicated, and if it should prove that other agencies are making some of these tests at useful check-points it would probably be advisable to make arrangements for utilizing their work. But, again, other agencies will not be checking project reservoirs or,

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[1]Lackey, J.B., 1945. "Plankton Productivity of Certain Southeastern Wisconsin Lakes as Related to Fertilization. II. Productivity." Sewage Works Journal, Vol. 17, No. 4, pp. 795-802.

in all likelihood, tributary streams. It would appear that data collection could best be articulated and coordinated if it were conducted from a single office of the ARDP research effort. Information resources that can be drawn on are:

Reservoir Research Center, Oklahoma State University, Stillwater, Oklahoma. Dr. Rex L. Eley now at Southern State College, Magnolia, Arkansas, did a comprehensive study of Keystone Reservoir in Oklahoma.

Dr. Joseph Nix, Ouachita Baptist College, Arkadelphia, Arkansas has studied water quality in the area and is presently studying effects of impoundment on water quality.

Statistical model for diversity index

There are many possible mathematical expressions that can be used as measures of diversity, when sampling communities composed of different species.[1] These all involve some combination of number of species (s), number of individuals of the species (n_i), and the total number of individuals in the sample (n).

Some examples are:

(1) Margalef (1951) $$d = \frac{s-1}{\ln n}$$

(2) Menhinick (1964) $$d = \frac{s}{\sqrt{n}}$$

(3) Patten (1962) $$d = -\sum_{1}^{s} \frac{n_i}{n} \log_2 \left(\frac{n_i}{n}\right)$$

The criteria for choosing a particular formula include non-dimensionality, independence of sample size (making possible the comparison of results of different-size samples) and approaching the asymptotic value with a reasonably small number of samples, progressively pooled.

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[1]Wilhm, Jerry L., "Biomass Units Versus Numbers of Individuals in Species Diversity Indices," reprinted from Ecology, Vol. 49, No. 1, Winter, 1968.

The formula (3) suggested by Patten is recommended as the best available diversity index for the types of studies needed in the present project. It stems from information theory and derives directly from Brilloin's equation for a measure of information.

$$d = \frac{1}{n} \left[\log(n!) - \sum_{1}^{s} \log (n_i)\right]$$

For large n, using the Stirling approximation for the factorial, we get the Patten formula (3).

By use of progressively-pooled samples (adding each additional sample to the sum of the preceding samples) the diversity index approaches an asymptotic value rapidly with the smaller index the result of greater stress (an increase in stress reduces diversity).

One advantage of this formula over others (such as Margalef's) is that rare species make only a small contribution to total diversity, so that failure to find the rare species in a particular sample has little effect on the diversity measure.

If it is desirable to use biomass units rather than members of individuals, the Patten equation can be restated as

$$d = - \sum_{1}^{s} \left(\frac{W_i}{W} \log_2 \frac{W_i}{W}\right)$$

Where W_i is the biomass of the ith species and W is the total biomass of the sample.

II. Water Quality of the Tributary Streams

It may not be immediately obvious why there should be separate research devoted to the tributary streams. However, many of the streams in the area are aesthetically unique and unlike the Arkansas River, which has not been a reliable source of recreation in the past, these streams provide a source for a wide variety of recreational pursuits.

Concern for streams is evidenced by the Scenic Rivers Bill and by the strong movement for stream preservation. This concern is well documented in publications such as: "Stream Preservation in Arkansas,"[1] "The Glover River: Development vs. Preservation,"[2] "Why We Must Preserve the Alcovy River,"[3] and "Crisis on the Cossatot."[4]

Streams in the basin area are of three major types, 1) mountain streams; 2) plains and lowland streams, and 3) major valley streams. In addition to streams having a high level of pollution and streams to which the public has no access, there are some 7,687 miles of streams in the basin that supply suitable habitat for stream fishing.[5]

Current--the rate of flow--is the primary controlling factor of the life within any longitudinal zone of a stream. The current also largely determines the composition of the substrate and both these factors are decisive in determining the kind of plant and animal life found within the stream.

Fish are the best indicators of the nature of the current and by noting the fish population that an area of the stream supports, it is possible to tell quite accurately what plant life and insect larvae one might expect to find.

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[1]"Stream Preservation in Arkansas," Report of the State Committee on Stream Preservation, Arkansas Planning Commission, February, 1969.

[2]Palmer, Charles, "The Glover River: Development vs. Preservation," 1970.

[3]"Why We Must Preserve the Alcovy River," Wharton, Charles H., Report delivered to the Georgia Conservancy at Winder, Georgia, June 28, 1969.

[4]Jack, Wellborn, Jr., "Crisis on the Cossatot," <u>Ozark Society Bulletin</u>, Winter, 1969-70.

[5]"Fish and Wildlife Resources of the Arkansas River Basin," Bureau of Sport Fisheries and Wildlife, United States Department of the Interior.

Trout, for example, are intolerant of temperatures above seventy degrees, cannot survive in water where the oxygen content drops below five parts per million, have a streamlined body form that makes them well adapted to fast currents. Even their spawning habits are geared to a particular kind of stream where eggs can be laid in small spaces between stones and pebbles where they will be protected from the current yet assured of an ample oxygen supply.

The smallmouth bass, on the other hand, inhabits water that is slower and warmer. Its body is double-wedge shaped in cross-section and it could not navigate the current which the trout navigates so easily. Its spawning habits are adapted to a particular kind of substrate. Eggs are laid in open depressions that have been hollowed out in coarse sand or gravel by the male, who guards the brood until the fry can fend for themselves. In the sluggish lowland streams, the animal communities will resemble those of ponds and lakes.[1]

Vegetation is similarly adapted, and the importance of vegetation to aquatic animal life is dramatized by a comparative study made of a British stream. An area of one square yard of loose stone bottom was colonized by something over 3,000 animals. An area of similar size with a substrate consisting of algae-covered stones supported a population ten times that number, and finally, in a stand of pondweed over a bottom of silt mixed with pebbles, in an area where stems and branches from streambank vegetation provided many additional levels for attachment, the number of inhabitants was six times that of the algae and stone substrate.

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[1]Bardach, J., Downstream, The Universal Library, Grosset & Dunlap, New York, 1966.

Impact from the Arkansas River Basin Project on life within these streams is expected to result primarily from backwater effects, channelization and reservoir inundation. It is presumed that each of these effects will play a role in altering the water quality of the tributary streams by possible changes in flow, in turbidity, temperature and in the composition of the bottom. Alteration of the vegetation along stream banks will affect the interchange between land and water on which streams depend for much of their energy source.

Fish are the usual economic and recreational yield of stream productivity. Their study has obvious applied value in assessing project impact on tributary streams. In a study of twenty-three channeled streams and thirty-six proximate natural streams in eastern North Carolina, it was found that after forty years there was no return toward a natural stream population.[1] To evaluate impact on the tributary streams an ongoing survey is necessary both to account for the kind and amount of alteration in fish populations and to measure the rate and time of possible recovery. Presumably, if the stream is kept channeled, recovery will never occur.

Suggested Research:

1. Ascertain the number of miles and acreage of stream habitat inundated by water impoundment. (Note that in 1960 it was predicted that 258,000 acres would be lost in Kansas, Missouri, and Oklahoma. There was no estimate for Arkansas. However, it is known that construction of the Arkansas Post Canal Dam and Lock No. 1 alone inundated 3,500 acres of the White River National Wildlife Refuge.) The impact in this case is total and a result of the ARDP.

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[1]Bayless, J. and W. B. Smith, "The Effects of Channelization Upon the Fish Populations of Lotic Waters in Eastern North Carolina," Division of Inland Fisheries, North Carolina Wildlife Resources Commission.

2. Study impact on streams that have been altered by the ARDP channelization in terms of fish populations.

   A. Make a survey of such streams by classifying them according to fish species for which the water are suited (e.g., trout feeder, bass stream, pickerel stream, etc.). Ecological classification of a stream can conveniently be made based on modification of a method described by R. D. Van Deusen in The Progressive Fish Culturist.[1] Record width, depth, temperature, water quality, (pH, alkalinity, turbidity, D.O.), flow, volume, characteristic forms, shade and cover, miscellaneous characteristics.

   B. Choose comparable streams (by using the same method of ecological classification as suggested above) with sections that have not been altered and record the same data for those sections.

   C. If an altered stream has been disrupted to the extent that the physical characteristics and fish populations have been so drastically altered that the natural classification cannot be determined, then it will be necessary to choose an adjacent unaltered stream of the same size as the control and conduct the survey of this substitute stream.

   D. Make yearly checks of fish populations in the streams of A, B, and C. Record the average weight per surface acre and the number of fish exceeding six inches in length per acre both for game fish and rough fish. Make comparisons between yields of the channeled streams and

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[1]Van Deusen, R. D., "A Simplified Technique for Classifying Streams Useful in Fishery and Related Resources Management." The Progressive Fish Culturist, Vol. 15, No. 1, pp. 14-19.

the comparable natural stream counterpart. Comparison of these results will record impact from the ARDP.

The time elapsed between channelization and the survey must be known to establish the rate of recovery.

Resources:

State Game and Fish Commissions provide personnel who are professionally capable and also have intimate knowledge of the respective areas. These agencies have made knowledgeable estimates of anticipated effects from the project and they are the logical researchers for continued surveys.

III. Bank Vegetation and Wildlife

Within the littoral zone of a given body of water, is the zone of rooted vegetation which supports a great deal of aquatic life, offers a link between water and land, supplies food and shelter for amphibious animals and provides entry and exit for aquatic insects.

Beyond the littoral zone, the area of shore and stream bank becomes a transitional area between the aquatic environment and the terrestrial environment. This area supports a habitat which is used by aquatic animals, terrestrial animals and communities of animals unique to a transitional zone. Large numbers of both birds and higher animals make the streamside their home, and this tendency for increased variety and density is described as the "edge" effect. In addition to supplying habitat for diverse kinds of animal life, stream bank vegetation prevents erosion and supplies enrichment to the stream itself.

The importance of the edge environment is heightened in sections of prairie and in sections intensively farmed. One need not be a wildlife expert to view a vegetative map of Oklahoma and draw conclusions as to the importance of the stream bank habitat for wild life cover.

Because of the encroachment upon this habitat from a variety of sources, it may prove difficult to single out causes of disturbance. Land is being rapidly cleared in the area as a result of Public Law 566. In Oklahoma during the years 1965 and 1966, 40,383 acres have been cleared and 179,237 acres sodded in Bermuda grass.[1] This permits grazing of cattle to the water's edge. In some areas of Arkansas, land is farmed so close to the streams that "they farm until it is dangerous to walk close along the bank."

Where this conversion to cropland or pasture has been enabled by additional irrigation water from the ARDP, project impact is clearly involved; and certainly it is the total impact where bank clearing and stabilization is the objective. Whatever the source, the various stresses work in concert so that it is necessary to regard streambank vegetation along the Arkansas as a deeply endangered habitat.

Unfortunately very little research is available which supplies information on methods that could be applied to study this problem. Russell, in the introduction to his study of wildlife stream bank habitat in Kentucky mentions that in reviewing the literature he could find no reference to any special studies of this habitat.[2] As he states, stream work has been concerned primarily with water quality and fish resources. Because of the interaction and interdependence of bank composition and water, bank habitat is an important consideration even if the area of concern is limited to water quality and fish resources. There exists, therefore, a very obvious need for meaningful research in this field as well as the establishment of methods that can be used to acquire adequate data.

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[1]1965 Agricultural Conservation Program-Oklahoma, Estimated Accomplishment Summary, May 1966. Notice ACP 542; Exhibit 1.

[2]Russell, Dan M., "A Survey of Streambank Wildlife Habitat in Kentucky," Pittman-Robertson Game Management Technical Series No. 16, Department of Fish & Wildlife Resources.

The loss or alteration of habitat can be ameliorated by land use which permits reestablishment of native climax vegetation. Unfortunately, advancing seral stages are not always attractive to man and the spraying of colonizer plants,[1] the permitting of grazing rights along the water's edge, will exacerbate the conditions that have resulted from clearing and inundation of habitat.

Much is already known about the foliage common to the different vegetative strata along stream banks. Seral stages are, or can be, determined. As noted below, from a survey based on vegetation it is possible to make meaningful classifications which will supply accurate information useful in interpreting the amount and kind of wildlife which the habitat will support. For many reasons, not the least of which is the life forms, a diversity survey such as this will allow for a more reliable, as well as accessible, assessment of impact than one based on a comparative study of animal populations.

It should be noted that had a total survey of bank vegetation along the length of the Arkansas been done, and a correlation made between animal species and vegetation, a computer program could have been written which would have printed out wildlife losses as habitats were altered. Mr. Hugh Cutler, of the Missouri Botanical Gardens, St. Louis, who suggested this kind of survey, points out that it would not have represented a large-scale undertaking even for a mainstream the length of the Arkansas--where, of course, it is no longer possible. For consideration in future projects, however, it would be the recommended technique for determining actual impact.

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[1]Bagby, George T., "Our Ruined Rivers," Georgia Game & Fish, Vol. 4, No. 7, July, 1969.

Procedures for vegetation-wildlife survey

I. Selection of Sampling Sites

Areas of stream banks should be selected for study along those same streams which have been singled out for studies of fish populations--the unaltered streams again providing control areas, while the altered streams provide impact data.

II. Sampling Method

A winter inventory and classification of all plants 2cm and more in diameter and 10cm and more in height should be made on these altered and unaltered stream banks. One surveyor and two botanists familiar with the area can acquire this information from a single season's survey. From this total survey of vegetation, competent zoologists can make quite accurate assessments of the amount and kind of wildlife which the contrasting habitats will support.

III. Replication Surveys

In order to monitor the long-term effects of bank clearing, bank stabilization and seral stages of recolonization, the most promising of the altered sampling sites should be surveyed annually for accumulation of adequate data.

IV. Quantification

Quantification of the data derived as above clearly presents problems. On a per acre basis, averaged data from the control sites will have to serve as an index for estimating losses from totally destroyed areas of stream bank. Quantification of the various levels of alteration and recovery will have to be estimated by the surveying botanists, whose familiarity with the particular survey area is assumed.

Resources:

Any of the following specialists is eminently qualified to conduct the proposed surveys or to recommend others competent for the local areas.

Oklahoma: Leland E. Roberts, Department of Wildlife Conservation, Oklahoma City, Oklahoma. This department is in the process of inventorying quantitatively and qualitatively the Oklahoma vegetation for eventual application to a technique of game census.

Arkansas: Dr. Delzie Demaree, 109 South Avenue, Hot Springs, Arkansas, is generally considered the outstanding plant taxonomist of the area. Dr. Demaree is currently involved in correlating deer populations and plant types.

Walt Green, P. O. Box 64, Harrison, Arkansas 72601, works as a researcher in a National Research Forest. He is one of the most knowledgeable wildlife experts in the area and has recently been associated with Dr. Demaree in the study noted above.

William Allen, Field Representative, Wildlife Management Institute, P. O. Box 1143, Hot Springs, Arkansas 71091.

IV. Bottomlands

Bottomlands represent perhaps the most widely endangered kind of habitat in the nation and are the subject of most widespread concern. As such, and in consideration of their wholesale destruction in the Arkansas River Basin,[1] it is felt that a special effort should be made here to establish what happens as a result of alteration. Only a truly special effort can accomplish this

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[1] In "Fish and Wildlife Resources of the Arkansas River Basin," the Bureau of Sport Fisheries and Wildlife, U.S. Department of the Interior, July 8, 1960, the following projections were made for the Kansas, Missouri and Oklahoma portions of the river only: channelization and flood control measures would reduce wetlands habitat by 28,000 acres; reservoir construction would inundate 230,000 acres of bottomland; about 96,000 acres of bottomland would be cleared for conversion to agricultural use.

objective. Certainly, little is presently known in any definitive way about the effects of alteration, although some highly pertinent studies are underway, as we shall note.

The one assertion which can be posited with certainty is that in these primitive areas the natural fluctuations of the water table and the species composition--both floral and faunal--represent a steady state. Beyond that, we know only that the relationships, including the time factor of duration of low- and high-water levels, are incredibly intricate. Species tolerances are not only complex but differ for each species, and they have only begun to be worked out (until Franz's work, noted below, is published, the gum Nyssa sylvatica has been a lonely example). Records of the natural fluctuations in water table are available from the U.S. Geological Survey; but alteration--increased high levels, decreased low levels, differing periodicity of fluctuations both in time of occurrence and duration, and probably all of these in shifting combinations--will affect each species differently, and there will be some interaction between species. Only a computerized program, clearly, can effectively answer the question: What happens when the natural water fluctuations of bottomlands are altered? Such a program is presently being designed in connection with the Sangamon River (Allerton Park) development by Eldon Franz, 297 Morrill Hall, University of Illinois, Urbana, Illinois 61801.

Franz has been studying an 80-acre sample of a swamp of 800 acres, working five strips, each 20 meters in width, from an upland elevation to the same elevation at the other end of the strip--thus providing an index to species tolerance (that is, with increasing elevation above the swamp level, viability decreases, until the point of species extinction is reached). Working with two botanists and a surveyor, readings are taken at the time of seed dispersal, seedling establishment and germination (April and May, for most of the species in the Allerton Park area). Monitor readings are taken annually at the same season and for the same strips, thus establishing survival rates and distribution of reproduction. With a good botanist and a good surveyor, a survey of this 80-acre size can be performed in one day: ideally, it should be performed separately for differing germinal seasons of genera of species.

Given the geographical proximity of the Sangamon area to the Arkansas Basin, the computer program of Franz, together with his determinations of species tolerance, should prove highly adaptive to the present study. It is strongly recommended that the research effort make use of this original and, to date, unique model.

With reasonably patterned variations in the water table, Franz believes his computerized model will be able to provide fairly accurate predictions of species distribution over a period of 50 years or more, since his studies provide an index to the reproductive response over the full range of what he calls "the environmental repertoire." With erratic fluctuations in the table, as may be the case along the controlled Arkansas River, however, data on species survival and reproductive characteristics must be carefully correlated with the particular hydrologic regime of that year--again, reason for computerizing the study.

But to think of river swamps solely in terms of habitat is to neglect their full function as a fluctuating-water-level ecosystem. River swamps have provided a most important natural mechanism for control of water pollution, and a full assesement of impact must consider two effects: that on water quality, and that on productivity.

Water quality

River swamps have been called "giant kidneys," since they act as buffers against sudden surges of wastes, protecting areas downstream. The Flint River in Georgia, for example, receives massive amounts of pollutants from a variety of sources--a total estimated at 5 million gallons per day. A study of the Flint River[1] by the Georgia Water Quality Control Board indicated that the cleansing action of six miles of swamp (620 acres) was equivalent to the sewage treatment for a city of 50,000 (100 gallons per capita). Unfortunately, it is not possible at this time to say with exactitude how typical this purgative performance may be, since studies of the function have only begun (the Flint and Alcovy rivers in Georgia, to date). The performances studied have, however, been impressive enough for Wharton[2] to generalize:

> The value of swamps in regard to water quality is multiple and the effects on wastes are similar to that of the combination of the primary treatment plant plus the treatment afforded by a waste stabilization pond.

In view of the magnitude of the problem of water pollution, this valuable function of river swamps is obviously a priority subject for intensive study, and loss of the Arkansas River bottomlands--somewhere between 28,000 and 345,000 acres of river swamp--represents a significant impairment of the river's ability to purify itself.

A study should be made of the purgative capability of an area of swamp and stream in the ARDP region, from which a simple extrapolation, based on the number of acres of river swamp lost as a result of the ARDP, can be made of

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[1]"Flint River Water Quality Study," Georgia Water Quality Control Board, Atlanta, Georgia, January, 1971.

[2]Wharton, Charles H. "Southern River Swamp," Bureau of Business and Economic Research, School of Business Administration, Georgia State University, 1970, p. 23.

replacement facilities required to perform the same amount of purification. Clearly, it would not be difficult to convert this value-lost into dollars of plant investment and maintenance. In fact, Wharton makes precisely this calculation for the Flint River swamp.[1]

A length of stream and number of acres flushed can be considered as a unit. A water quality check would then be made on the stream at the entrance into the swamp, and again at the location where the river leaves the swamp. Measurements should be taken monthly from April through November. Date, time of day, and air temperature should be noted. Measurements to be taken:

1. DO mg/l
2. BOD_5 mg/l
3. pH
4. Alkalinity (total) mg/l as $CaCO_3$
5. Suspended solids mg/l
6. Dissolved solids mg/l
7. Specific conductance (micromho/cm 25°C)
8. Fecal coliform

Data for this study can be acquired by one individual during the monitor period.

<u>Productivity</u>

River swamps are among the most productive of the world's environments, with an estimated gross primary production between 20,000 and 40,000 kilo calories per square meter per year. In the Georgia studies, it was found that

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[1]Wharton, op. cit., p. 26.

the Alcovy River swamp produces from 10 to 13 times more fish protein than does the river channel itself.

As suggested above, the only completely serious approach to assessing the impact of alteration on this highly special ecosystem would be a computer program registering the response of each species to the several variables. The baseline productivity of the Arkansas River is not known, and at this point nothing whatever is known--either in the study area or in the swamplands of the southeast--of the effects of alteration in the natural water-level fluctuations. The model computer program being elaborated by Franz at Urbana is clearly adaptable to the Arkansas Basin situation, although specific techniques for its use would have to be devised by the research team. Offhand, annual monitoring of at least two kinds of river swamp would appear to be called for: one in the delta bottomlands and one at a point well upriver, at least above Little Rock. A time horizon of 20 years would appear to be minimal.

Until such a truly comprehensive study is made, all statements as to the effects of altered water tables must necessarily be blind guesses, however "educated." Nevertheless, a less costly and much simpler kind of survey which could provide extremely useful corollary information has been proposed by Dr. F. Eugene Hester of the zoology department of the University of North Carolina.[1] Dr. Hester's proposal, which could easily be duplicated in the ARDP region, contemplates the work of only two graduate students over a three-year period. The first two years would be spent in data collection, the third

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[1]Proceedings, "Workshop on Stream Channelization and Wetland Drainage." Water and Air Resources Research Institute, University of North Carolina. November 18, 1970.

in writing an analysis of the findings. The study would concentrate on measurement of fish, water-related birds, and mammals, without reference to such considerations as quantity or quality of water, effects on hardwood timber stands or agricultural yeilds as a result of drainage.

Fish populations

One-half to one acre would be taken, an area of a size to permit one student working in fisheries to measure such things as pounds per acre, species, size relationships and predator-prey relationships. These together would help to determine carrying capacity and aspects of the food chain to derive an understanding of the basin internal working relationships of the fish population. Population would be determined by marking and recovery. One student working half-time for two years would acquire the data.

Bird and mammal population

The survey would focus on utilization of the area by water-related organisms such as waterfowl, woodcocks, snipe, rail, and furbearing mammals for nesting, rearing the young and winter feeding. Seasonal changes would be specifically measured. The bird population would be checked by the following method: 100 birds would be caught and banded; then samples of ten birds would be caught in different areas of the swamp until consistent results were obtained between banded and non-banded birds. Percentage of banded birds in the standard sample catch will then represent the percentage of total banded to the total population.

Ground assessments of the various water-related birds and mammals would take two years and could be accomplished by the two graduate students.

<u>Harvest of fish and wildlife</u>

The cited Proceedings gave no methodology for measurements of recreational use. Hunting and fishing can be assessed by the methods used in the National Surveys of Fishing and Hunting by the United States Department of the Interior, Fish and Wildlife Service.[1] Surveys are based on a subsample of persons previously selected from the Current Population Survey (CPS) of the labor force, conducted monthly by the Bureau of the Census. Such a survey can be conducted in selected counties during the latter part of January and compared with counties similar in game potential but outside the area. Such a survey can determine:

1. Number of persons who engaged in hunting or fishing.
2. Hours per day spent in hunting or fishing.
3. Kind of game hunted.
4. Kind of fish desired.
5. Miles traveled.
6. Expenditures by fishermen and hunters.
7. Size and numbers of game killed: small game, big game, waterfowl.
8. Weight and species of fish caught.

An excellent alternative survey method is to have hunters (and fishermen) surrender their licenses at entrances to the area. Day permits are issued. Licenses are then returned when survey data has been obtained.

<u>V. The Recreation Environment</u>

Recreation is a major secondary purpose in the ARDP and--given accurate and adequate techniques of measurement the assessment of impact does not, for

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[1] <u>National Survey of Fishing and Hunting</u>. United States Department of the Interior, Fish and Wildlife Service. Resource Publication No. 27.

the most part, pose procedural difficulties. For the numerous facilities newly provided by the ARDP, the baseline date is the opening to public use, and all measured activity (with a factoral discount for transference of use from previously existing facilities) represents impact. With generalized activities such as hunting and stream fishing, of course, the assessment of impact is considerably more complicated.

The ARDP increase in total water acreage within the region has very considerably raised the potential for water sports (swimming, boating, water skiing), for lake fishing, and for related lake-oriented resort development. On the other hand, negative effects on stream fishing and hunting have resulted from stream inundation, channeling and other drainage activities, as well as from direct conversion of recreation land to other uses (e.g., the removal of a large section of the National Wildlife Refuge to build Lock and Dam #1 in the White River region).

In 1964, a survey by the Division of Planning and Research of the Arkansas State Highway Department showed that there was a negative balance of recreation travel in and out of the ARDP region, even though the state as a whole had a large positive balance. There were approximately 534,000 trips into the region from outside the state (representing 1.5 million visitors), and 641,000 trips by residents to out-of-state areas (representing 1.9 million people). These figures provide a significant baseline for assessment of the generalized impact of the ARDP features.

Recommendations:

I. Overall Recreation

A. Repeat the regional survey by the Arkansas Highway Department referred to above at 5-year intervals to check efficacy of recreational sources.

B. Establish realistic and statistically meaningful systems for counting users of recreational facilities.

1. For overnight camping facilities, random sampling of actual campers at least once weekly in the summer season for determination of factor to apply to traffic count. It is understood that the CE presently derives this factor from spot checks made once or twice per year. Knowledgeable experts in the area find that existing estimates of use are severely inflated.

2. For boating, checks at marinas and boat-loading docks should be used.

3. For swimming, actual counts at parking facilities should be equated with actual people-counts at beaches to provide an accurate individuals-per-vehicle ratio and at the same time give a realistic base for estimating usage.

4. For fishing and hunting, license information and game wardens can supply adequate measure. Reliability of data obtained from hunter questionnaires or interviews is highly unreliable: can be obtained if the techniques recommended in the foregoing (bottomlands) section are followed.

5. For commercial resort facilities, semi-annual surveys in the impact region should be made of number of overnight units and occupancy rate.

II. Fishing

A. Streams

1. Make check of mileage and acreage inundated by ARDP.

2. Make fish population counts on comparable altered and unaltered streams (see section on streams) and derive impact of alterations.
3. Keep records of number and quality of access points to streams and availability of campsites (baseline data starts now).

B. River

1. Check river water quality (see section on river) and fish populations to determine effects of changing water temperatures below dams, pollution from industry and farm run-off.
2. Check fish for DDT and mercury contamination.

C. Reservoirs

The trend in reservoirs, over a period of time, is for game fish to be replaced by rough fish. Since reservoirs are entirely project-created, it is clearly inadequate to measure impact without an effort to control it. Recommendations 2, 3, and 4, below, are therefore prophylactic in thrust.

1. Make regular population checks of fish to determine the status of game and rough fish.
2. Seine rough fish out at regular intervals to prevent take-over.
3. Check adequacy of seining areas (locations should be selected by Bureau of Sport Fisheries and Wildlife and by state conservation agencies).
4. Construct brush shelters in reservoirs.

III. Hunting

A. Big Game

1. Check present deer populations. Compare with numbers before ARDP. Use as control the relative changes in deer population in comparable upland areas that have not been altered.

B. Small game (squirrel, rabbit, quail, etc.).

State game commissions can provide baseline data and present status for each of the small game species. Hunting license information can measure impact on usage.

C. Waterfowl

1. Inundation of 20-25% of White River National Wildlife Refuge by Lock and Dam #1 is the major impact by the project on waterfowl areas. The Bureau of Sport Fisheries and Wildlife should be requested to give baseline data and present census of waterfowl in the refuge.

2. Wetland destruction (see section on Wetlands) reduces waterfowl areas. State game and fish commissions should provide before and after figures. Figures for comparable unaltered wetlands should provide a measure of the projected waterfowl populations if the ARDP had not altered the wetland. Hunting license information will show impact on usage.

IV. Water Sports

A. Boating

1. Periodic checks at marinas and launch sites on reservoirs will provide a measure of the positive impact on this recreation form (lake boating).

2. Periodic counts on the river will provide information about increase or decrease of boating activity on the river (no baseline data on river boating before ARDP is available).

B. Swimming

1. Periodic count (see I. B-3) would provide positive impact data.

2. Pollution measures (fecal _E. coli_ checks) weekly to increase positive impact.

C. Water Skiing

1. Periodic count of water skiers in reservoirs.

2. Check pollution.

Summary:

In most cases there is no baseline data available and it will therefore be necessary to establish the present information as the baseline for future checks. However, it should be noted that the original survey by the Fish and Wildlife Service as provided by the Fish and Wildlife Coordination Act, 48 Stat. 401, as amended; 16 U.S.C. 661 et seq., does supply estimates of impact on fish and wildlife in the ARDP area. After project completion, a yearly survey by this same agency could provide expert assessment of impact on fish and wildlife.

Resources for research on impact on the recreation environment:

1. Oklahoma office of the Federal Fish and Wildlife Service.

2. Arkansas Highway Department, Division of Planning and Research.

3. Harold Alexander, Resource Recreation Specialist, Arkansas Planning Commission, Little Rock, Arkansas. Mr. Alexander has a very thorough knowledge of the area, has been involved with studies of recreation in Arkansas and is an ecologist who has spent a great deal of time as a fish and wildlife expert.

4. State Fish and Game Commissions.

5. Forrest Romero, Field Supervisor, Tulsa Office of River Basin Studies, P. O. Box Drawer 1619, Tulsa, Oklahoma 74101. (Mr. Romero is also President of Oklahoma Ornithological Society.)

PART V

WORKSHEETS FOR THE PROPOSED RESEARCH

In the previous section there was an attempt to discuss at length the research needs to study the impact of ARDP, including extensive discussion of theoretical and methodological considerations involved, and including considerable discussion of research technique possibilities. In this section we attempt to summarize the specifications of the research program that we would recommend. We have tried to organize this specification into specific research tasks. Our criteria for a separate task is that of the possibility of procedural rather than logical separation, in the sense that we can see each task as an integral piece of work requiring particular kinds of skills. To be sure, some of the separate work efforts would be closely related in one of two ways--either the outputs of one work effort would feed into another, or there would be overlaps in the kind of personnel needed to direct the efforts and/or the kind of data needed, or both. We have tried to indicate the more important of these connections in our description of each work effort and have discussed closely related efforts in sequence.

It should be noted that in this section there is no attempt to justify the pieces of work or to describe in detail the appropriate methodology. These topics are covered extensively in Part IV. Also, in specifying the staffing requirements for each work effort we did not attempt a table of personnel organization but only to indicate the kinds and levels of professional skills required. The estimations of cost obviously must be regarded as very rough. They are mainly based on a judgment as to what the order of magnitude of the cost would be in a situation of contract research with a university. Obviously, depending upon the administrative arrangements some scale economies could be achieved, but it would seem that a really complete job would require a total of about $2 to $3 million over two or three years, with continuing costs perhaps averaging about $300 to $500 thousand per year.

So far as organization is concerned it does not seem to us that great centralization of effort would necessarily be required, although there would be considerable advantages to some centralization on three accounts. First, there are important functional connections and some data overlaps between the input-output and industrial location work. Also, both of these are efforts of considerable scale and will be carried out over a long period of time. For this reason we feel that much of this work, or at least very close direction of it should be consolidated.

Second, as will be clear from reading this section, a variety of field survey efforts will be required if a serious effort at understanding sociological impacts is to be made. Thus it would seem that there would be a substantial economy to be gained in establishing an Arkansas Basin survey center. This center should design all of the survey research, conduct the depth interview work itself, and carry out the analysis. The execution of routine survey interviewing could be subcontracted to an established survey research organization.

Finally, it would seem important that there be some permanent unit with a permanent responsibility for overseeing the total effort. We feel that it would be desirable to establish this within CE, but only if it could be established with the surveillance of this research effort as its only responsibility.

1. RECALIBRATION AND/OR RESECTORING OF 1963 INTERREGIONAL INPUT-OUTPUT MODEL

This work refers to revisions in the input-output model developed for 1963 in Development Benefits of Water Resources Investments (DBWRI). Two options are possible. First, the 23-sector model as it stands could simply be recalibrated for a 2 or 3 region case (either Arkansas Basin vs. rest of US, or Arkansas Basin vs. rest of Ozarks vs. rest of US., although many more than 3 regions could be accommodated if greater detail in extra-Basin effects were of interest. In any event, the recalibration of the regional definitions would be relatively simple, involving no new data collection. Second, the model could be regionally recalibrated and the number of sectors expanded to include more industrial categories (perhaps as many as 40 or 50 in all) as discussed. This would require the collection of data for each new industry and considerable recalculation of coefficients, although the format for such recalculations would be the same as in the earlier model.

Staffing requirements:

One senior and one junior economist experienced in input-output, with several research assistants, clerical help and computer time.

Timing:

This would be a onetime study, to be done as soon as possible and would take from 6 months to a year.

Cost:

For recalibrating regions only a modest sum, perhaps $10 to $25 thousand. For adding additional sectors much more, perhaps $50 to $75 thousand.

Remarks:

If resectoring is to be done, this should be decided on at the beginning as it could be done simultaneously with the regional redefinitions. We would recommend resectoring, if possible. We do not recommend more than 3 regions at most, although extra regional breakdowns would not add too much cost. But they should be employed only if subsequent tables for the future would have the same amount of detail.

2. ESTIMATION OF INTERREGIONAL INPUT-OUTPUT MODEL FOR MOST RECENT YEAR POSSIBLE

This would involve the data collection and calculation of an input-output model for the most recent year possible (probably 1968, as that was the latest Census of Transportation year) in exactly the same format as was decided for the revised 1963 model.

Staffing requirements:

Same as for revising of 1963 model with additional clerical and data collection cost.

Timing:

Onetime study that would take about one year.

Cost:

About $100 thousand.

Remarks:

There would be no inherent economies of scale in doing the 1963 revision and the new 1968 table together, but there would be some clear advantages in terms of insuring consistency and economizing on computer programming in having the two jobs done by the same group.

3. INTERREGIONAL INPUT-OUTPUT MODELS FOR FUTURE YEARS

Interregional input-output models in the same format as the revised 1963 and 1968 tables would have to be formulated in future years in order to assess indirect impacts for past years as of 1980, 1990, and perhaps later years. How often they should be calculated is debatable since they do represent expensive efforts. Certainly, every 5 years would be as often as necessary and at least every 10 years would be the longest it would seem possible to wait.

Staffing requirements:

Same as for proposed 1968 model.

Timing:

If possible, every 5 years beginning with 1973, or every 10 years beginning with 1978.

Cost:

About $100 thousand per calibration.

Remarks:

While this kind of study will go on periodically throughout the period of impact study, it cannot really be thought of as an ongoing effort because of the long time between work efforts. It is important that careful documentation of data sources and programming methods in the 1968 study be kept for later use. This is important as it is unlikely that the same group would do the work in 1973, much less 1978, if that were the next point of study.

4. DEVELOPMENT OF PROGRAMMING MODELS OF INTERREGIONAL LOCATION FOR INDUSTRIES SENSITIVE TO WATER TRANSPORTATION RATES

This is the most difficult of the economic studies envisaged. It involves assembling the data and developing the programming models for estimating the shifts in equilibrium locational patterns of the various industries affected by water transportation rates in order to estimate how much of the observed change over any prior period could have been predicted from the presence of water transportation from the ARDP. As suggested, this would involve covering several industries, and each industry should be regarded as a separate study. While some further work on refining the programs is needed, the model developed in the DBWRI study and the further conceptual specification in this study cover much of the ground needed to be covered at least for the kind of "backward estimation" envisaged here. The bulk of the research effort will involve a very difficult data collection effort. This would include, for each industry studied:

Unit production cost in each representative producing location

Delivered price of each major input

Quantities consumed and delivered prices paid in each major market location

Transport rates from each major production point to each major market

This would be in addition to relatively standard information on employment, output, etc. at each location.

Staffing requirements:

A senior economist experienced in production function estimation, an economist experienced in programming models, and a staff person experienced in transportation rate setting. In addition, clerical help and computer time.

It would seem best to have a separate team for each industry, although all teams should have a central direction with close control on consistency. Also, by cooperation some economies in data collection could be achieved.

Timing:

A major effort would be needed to calibrate the models for the initial period selected. This should be the year 1968, as there is a Census of Transportation and it is very shortly prior to the time when the river was opened to commerce. Moreover, it is probably long enough before the opening of the river to catch most of the facilities put in place, even though they might have been planned earlier. After the initial effort which will probably take about two years, updating efforts should be made at least at two year and if possible annual intervals. Thus, a fairly continuous effort is contemplated.

Cost:

About $900 thousand for calibrating perhaps a dozen industries for 1968. This would take about two years. Thereafter about $200 thousand per year for five years--$100 thousand for picking up one earlier year after 1968 and $100 thousand for collecting data for the current year. After these first seven years the cost would drop to $100 thousand per year, the cost of that year's updating.

Remarks:

While some coordination with the input-output work would be desirable, there would not be much overlap in expertise and the only data collection overlap would be with regard to some of the interregional shipments data. Accordingly, there is need for some collaboration with the input-output studies although they need not be organizationally integrated.

5. EXTENSION OF PROGRAMMING MODELS OF INTERREGIONAL LOCATION FOR INDUSTRIES SENSITIVE TO WATER OR ELECTRIC POWER COSTS

This work effort should be regarded as an optional extension to the work on programming models for industries sensitive to water transportation rates. Essentially it would involve the same sort of work with two important extensions. First, additional industries would have to be studied. Second, additional data would have to be collected on the importance of water and electricity as inputs to the production processes.

Staffing requirements:

The same as for basic programming research effort, except that more manpower would be required.

Timing:

Same as basic programming research.

Cost:

About $100 to $200 thousand additional on the initial calibration, and about $50 thousand per year additional for maintainance.

Remarks:

Given that water supply should be significant for industry only in the western portions of the Basin, if at all, extension to cover water sensitive industries should receive low priority, at least until there is some basis for believing such industries might be attracted to the Basin. Given the very small power component of the project, extensions to electric power sensitive industries should be given very low priority.

6. EXTENSION OF PROGRAMMING MODELS TO INDUSTRIES SENSITIVE TO RAIL TRANSPORTATION RATES

This would represent the same kind of work as for the basic programming models except that the applications would have to be extended to many more industries. Unless a strong rationale can be built up for including responses to potential lowering of rail rates as part of the impact of the ARDP, we would strongly advise against such a research extension. It would increase the costs of the programming research very substantially, perhaps to two or three times their otherwise projected magnitude.

7. TIME SERIES STUDY OF NAVIGATIONAL IMPACT ON LAND VALUES

Two types of research are possible--multiple regression analysis, involving the articulation of an econometric model; and comparative analysis of land value trends in on and off river sites. Analysis by multiple regression is complicated by the problem of data recovery for a number of key variables, while comparative analysis is beset with the problem of finding comparable sites on and off the river. Since recovery of data is a matter of urgency for both approaches, it is recommended that large-scale data collection be initiated immediately. Comparative analysis can proceed on the basis of the data collected, and experience over time will indicate whether sufficient information is recoverable for implementation of a multiple regression model.

The most promising proposals for comparative site selection are: 1) an undeveloped area in the northwest quadrant of greater Tulsa adjacent to Catoosa compared with a similar area in the southeast quadrant; 2) a developed port site on a rural stretch of the river compared with an undeveloped port site immediately up river or down river, also on a rural stretch; and 3) a port town in each subregion of the project basin (excepting Little Rock and Fort Smith) with a roughly similar town not located on the river.

Baseline data should be for the year 1944, using Census of Agriculture reports aggregated at the county level, supplemented by other sources as indicated in the text. Data should be replicated from the same sources for the single years 1949 and 1954. Beginning with 1959, and relying heavily on county recorder sources in non-census years, data should be collected on an annual basis. The importance of 1959 is that Census of Agriculture data are still available at the township level, and this represents the richest and cheapest source for data collection. A very long time horizon is projected for this study, and after 1979 replication should be only at five year intervals, with the Census of Agriculture as the major data source.

Staffing:

Agricultural economist with background in land valuation, and an appraisal specialist familiar with the region, both on a consulting basis. In addition, a junior economist with research assistant support.

Timing:

About a one year study to assemble data at five year intervals from 1944 through 1969. Thereafter about a three to six month effort every five years.

Cost:

About $15 to $20 thousand the first year for assembly of data from 1944 to 1969. Thereafter about $10 thousand dollars every five years.

8. MONITORING OF ATTENDANCE AT RECREATIONAL SITES

Except for semiannual monitoring of commercial resort overnight units, this would be a simple job of collecting together the use figures for recreation facilities in the basin from administrative records. However, our research has emphasized the need for considerable refinement in techniques for estimating visitor and user totals, which appear to be severely inflated under present spot-check of automobile traffic. It is also necessary to caution that figures need to be kept for non-ARDP facilities in the region as well as for ARDP facilities in order to test for displacement effects.

Staffing requirements:

This should be possible as a routine function within the CE.

Timing:

An annual series should be kept, beginning at least with 1968, and if possible going back to 1965.

Cost:

$25 thousand for first year to take care of compiling backfigures and developing a reporting scheme. About $5 thousand per year thereafter.

9. SURVEYS OF RECREATION EXPENDITURES

This would involve a sample survey of recreation users only at ARDP sites. For respondents in such samples we would want to know their place of residence, their total expenditures on the recreational activity, including transportation to the site, and how much of these expenditures were made in the Basin area. We realize that for non Basin residents the definition of transportation to the site is ambiguous--their visit to the Basin might represent a trip diversion--but this is not important since for nonresidents we would only want to know their transportation outlays in the basin area.

Staffing requirements:

A recreation specialist to design the initial effort and to review it periodically. In addition any standard survey research unit for field interviewing and data processing. Samples large enough to produce about 300 nonresident users should be employed.

Timing:

Surveys cannot be made for past years, but efforts should be made as soon as possible. While part of the year is gone at least a summer survey for 1971 should be made. Samples stratified over the year should be collected for suceeding years.

Cost:

Based on a total sample of 1200 and about $30 per interview survey costs would run about $35 thousand per year. In addition there would be consulting costs of about $5 thousand the first year and perhaps one thousand dollars per year thereafter.

10. EXPENDITURE PATTERNS OF AREA RECREATION USERS VS. NONUSERS IN THE AREA

This survey would be confined to residents of the area. It would be designed to indicate whether individuals, in increasing their consumption of recreation, were switching to a bill of goods which had a different multiplier impact on the area's economy. The differential multiplier impact could be determined by the input-output analysis, if we knew what happened to consumption patterns of area residents when they consumed more recreation. Thus, we would need a simple budget survey of a sample of Basin residents in different income categories such that the sample would include at least a few hundred users and nonusers of outdoor recreation. A sample size of about 1000 probably would be adequate.

Staffing:

Consulting services of a specialist in consumer budgets and the services of a survey research unit.

Timing:

This study should be done once for an early complete year, probably 1972. If significant differences in spending patterns of a kind that would lead to different multiplier impacts were observed, it should be repeated every five years. If no significance is noted, it might be repeated once in ten years.

Cost:

About $25 thousand in 1972 and perhaps $20 thousand every five years thereafter, but probably no additional expenditure.

Remarks:

We would not expect the results of this research to be very significant and would suggest that eliminating it from the research design should be considered.

11. ECONOMIC LOSSES FROM LOSS OF TIMBER AND CROP LAND

Basically this involves assembling reliable data on acreage losses, estimating the annual loss in yield over the next few decades, and translating these yield losses into total losses in economic output, on the basis of the interregional input-output model.

Staffing requirements:

One forestry specialist, one agronomist, and one economist, plus normal staff support.

Timing:

This is a onetime study. The data on acreage losses and yield reductions should be made as soon as possible, presumably this year. The translation into total economic losses should be made as soon as the 1968 table can be operational, probably about 1972 or 1973.

Cost:

About $50 thousand over a two or three year peirod.

12. MONITORING OF WATER TABLE LEVEL

Whether the water table falls, rises, or stays the same is of considerable importance for agricultural productivity, especially in the lower reaches of the Basin. Accordingly, careful monitoring of the water table should be carried out. If significant changes occur, estimates would have to be made of the effects on agricultural output.

Staffing requirements:

The monitoring of the table itself presumably could be carried out routinely by Federal and State agencies without additional effort. The analysis of productivity effects would require an agronomist working on this particular topic.

Timing:

To be carried out annually.

Cost:

No cost for monitoring effort. If significant changes occur about $10 to $15 thousand dollars for analysis of productivity effects in the relevant years.

13. COMPILATION OF BASIC SOCIAL INDICATOR DATA

Essentially this work effort envisages simply the collection of the kind of data for each county in the Basin of the kind of information that would go into a Macro Index of Social Change as described in the report. At the initial stages of the total research effort, it does not seem that a clear specification could be made of just how a conglomerate index should be compiled and so the research would simply collect social indicator or profile data. For comparative purposes such information should be collected for all counties in Arkansas and eastern Oklahoma.

Staffing requirements:

A sociologist familiar with the literature on measuring social change and familiar with the Arkansas River Basin area. In addition, a fairly large clerical force.

Timing:

It is imperative that this work begin just as soon as possible as baseline data are being lost. It should be carried out continuously, with data for every year.

Cost:

Probably about $100 thousand dollars per year. After several years, when procedures have been standardized, costs might drop. In addition, another $100 thousand should be appropriated over the first two years for an attempt to reconstruct as much of the indicator information as possible back at least to 1960 and, where possible to 1950.

Remarks:

It should be emphasized that a prompt start is important as is familiarity of the research directors with the region.

14. METHODOLOGIES FOR SOCIAL INDEX FORMULATION

Ultimately the full use of the social indicator information depends on the development of techniques for synthesizing it, such as in an index of social well-being. The present state of the art is not very well developed in this direction. Moreover, the problem is a general one, not necessarily one of developing an index for the Arkansas Basin. In addition, there is a good deal of work going on to develop fundamental methodologies. Accordingly, we feel it would not be sensible for the CE to try to solve the general problem of the methodology on its own. What we do recommend, as elaborated in the text, are specific relevant indices (e.g., a Self-Support Index, a Consumption Quality Index, a correlation of crime statistics with in-migration and population growth), coupled with a close surveillance of developments in the social indicator field with the intention of applying useful innovations to the research as they emerge.

Staffing requirements:

A very skilled sociologist who is a specialist in social index construction, who may or may not be familiar with the region. In addition, it would be desirable to have an initiating conference and a review conference at least every two years, directed by the staff sociologist, but including consultants drawn from experts on social indices and, most importantly, experts on the sociology of the Arkansas Basin area. After a thorough review of the literature in 1971, it would be desirable to aim for a conference in 1972.

Timing:

Continuous study with biennial conferences for about 5 years. After that time, the results of the research could be incorporated into the ongoing social indicator research and this work suspended.

Cost:

About $20 thousand annually, plus about $10 thousand every two years for a review conference.

15. RESEARCH ON ATTITUDES ABOUT PROBABLE EFFECT OF ARDP

It is possible that part of the discrepancy between what will take place in the way of economic development and what would be estimated on the basis of the economic variables would be due to under or over optimistic expectations with regard to the probable effects. Accordingly, a survey should be taken as soon as possible to determine how much growth the people of the region foresee. A sample of about 500 respondents probably would be adequate. It should represent a cross section of the population, but should be weighted in favor of financial, business and governmental decision makers.

Staffing requirements:

Consulting services of an expert on attitudinal research and normal surveying facilities.

Timing:

Study should require about 6 months and should be taken as soon as possible. It should be repeated once in about 5 years.

Cost:

About $20 thousand in the first year and the same amount about 5 years later.

Remarks:

If it is not possible to trace a relationship between attitudes and future developments in the first five years, the second survey could be eliminated.

16. ASPIRATION LEVELS OF LOWER SOCIO-ECONOMIC GROUPS

Whether the economically warranted rate of expansion that would be indicated by comparative cost considerations would in fact come about would depend on an adequate labor supply response. In part this would depend on the upward mobility expectations of workers. Accordingly, a survey of aspiration level should be made as soon as possible, and if it can be related to economic growth it should be repeated in 5 years.

Staffing requirements:

Roughly the same as for the attitude research study.

Timing:

About a six month study, to be done as soon as possible and perhaps repeated in five years.

Cost:

About $20 thousand in first year and, perhaps again in 5 years.

17. PANEL STUDY OF OUT-MIGRANTS FROM RURAL COUNTIES

In assessing the impact on the total social structure of the region, it is important to understand the dynamics of population change of rural residents. What is happening to a rural county can be ascertained from the social indicator data already discussed. But this will not tell us what is happening to people. For this, we should select a panel of about 200 randomly selected rural family heads and follow their place of residence and economic and social status each year (or until they leave the region). In addition, for the next ten years we should select a new panel of 100 families every two years, following their performance similarly.

Staffing requirements:

A consulting sociologist with a background on social mobility, plus a survey organization.

Timing:

Continuous

Cost:

About $15 thousand the first year, $10 thousand per year for the next 10 years and $5 thousand per year for the next five years.

18. MANAGERIAL IN-MIGRANTS TO URBAN COUNTIES

Another important aspect of the social dynamic which is relevant to the extent of economic response to economic opportunity involves the flow of professional, proprietary and managerial workers to urban counties in the region. Obviously, since a large share may come from outside the region, we cannot use a panel research technique. The best that can be done is to carefully analyze the sources of in-migrants in these occupational categories at each Census period.

Staffing requirements:

Sociologist skilled in social mobility.

Timing:

About a six month study after each Census of Population.

Cost:

About $20 thousand every 5 or 10 years, depending on the frequency of population censuses.

Remarks:

Part of the reason for what seems high cost for a simple observation of census data is due to the desirability of analyzing the detailed information on Census summary tapes.

19. MOTIVATIONAL RESEARCH ON SKILLED, PROFESSIONAL AND MANAGERIAL IN-MIGRANTS

The basic dimensions of the character of the in-migrant flow of individuals in these categories can be determined by careful analysis of detailed Census information as described in the preceding research item. In addition, however, to fully understand the dynamic of social change and how such change is related to the ARDP, it is suggested that some consideration be given to survey research aimed at uncovering the motivations of such in-migrants. Some may come because of ARDP related amenities, most probably simply in response to economic opportunity (perhaps ARDP related, perhaps not), and some for other reasons. Untangling this mixture might be accomplished by surveying such individuals in new and expanding industrial facilities. This kind of research is very difficult, however, requiring skilled interviewing in depth. On the other hand, large samples are not required, perhaps about 100 respondents. It should be repeated every five years, preferably in the same plants in order to get as much sampling variance control as possible.

Staffing requirements:

Interviewers skilled in social pschological interviewing and consulting services of a senior professional in that area.

Timing:

About a six month study every five years.

Cost:

About $15 thousand every five years.

Remarks:

It is possible to presume that in-migration is necessarily a function only of economic opportunity, and hence migrational impact related to ARDP would factor out the same way as economic impact. Under this assumption this study would not be needed. On the other hand, if it is to be undertaken it should be begun as soon as possible as the historical record already is beginning to disappear.

20. IN-MIGRATION OR RETENTION OF RETIREES

One effect which has been predicated from the project is the increased attractiveness of the area as a retirement location. This would involve new people coming into the area and people who would have left the area but now will stay. The ARDP facilities probably will influence the choice of retirement location within the area for those who have already selected it, but this would be an effect of relatively little interest. The purpose here is to determine if the region's total retirement population will have been influenced by the ARDP. We feel the best technique here would be depth interviews of a relatively small number of retired people both from within the area and those who moved there. Perhaps something like 50 interviews might be conducted initially, with the experiment repeated every 5 years.

Staffing requirements:

A team of fairly skilled interviewers trained in social psychology.

Timing:

A six month study initially, perhaps to be repeated every 5 years.

Cost:

About $10,000 every 5 years.

Remarks:

Because of our skepticism as to the magnitude of the effect on total retirement, we would give this research fairly low priority.

21. SELECTED CASE STUDIES OF SOCIOLOGICAL EFFECTS

In addition to, or as a refinement of focus of the foregoing proposed particular investigations of sociological impact, special case studies of particular aspects of industrialization, changing land use, urbanization and institutional change should be undertaken after expert determination of their special cogency. As discussed in the text, selection of these peculiarly relevant factors is expected to develop from analysis of the collected macrosocial indicator data: the six studies of possible key variables and four studies of change processes cited in the text are not to be taken as prescriptive but only as representative of the types of investigation considered necessary. All would involve sampling of relevant areas and/or populations, and few, if any, would require replication: what is contemplated for these studies, at the most, is a single recheck to confirm a detected trend or validated hypothesis. Nonetheless, the importance of these special studies cannot be overstressed: given the infancy of the art of measuring social well-being, they present the best hope for tagging and tracing specific ARDP impact within the social sphere.

Staffing:

One senior sociologist and/or anthropologist, with locally expert consultative planning assistance, with field research staff as needed.

Cost:

Budget should be flexible, with a minimum $100 thousand per year and a maximum $200,000.

22. INVESTIGATION OF POLITICAL IMPACT

Apart from collection and analysis of data from such statistical indices as expenditures for services by state, county and municipal governments, and possible trends in tenure of elected officials, the investigative approach in this area inevitably consists primarily of judgmental analysis based on interviews and questionnaires of individuals involved in the political process and content analysis of campaigning techniques. All of these analyses are directed to detecting an expected process of "cosmopolitanization" of the region in consequence of ARDP inspired economic growth and in-migration. Involved in the process are anticipated changes in regional identity, in proliferation of governmental bodies, in shortened tenure of political office, in role conceptions of appointive and elected officials and in the style of political campaigns.

Staffing:

A political scientist familiar with the area, with assistance of a political sociologist conversant with theory of social elites. In addition, field survey staff.

Timing:

This area of study is marked by a particularly long time horizon, since change is expected to be slow and in small increments. At the same time, periodic checking should be geared to terms of office. These factors suggest a light sampling of the selected indices at two or three year intervals.

Cost:

About $25,000 every two to three years.

Remarks:

This effort should be carefully scrutinized and, if after several years no relationships can be traced, it should be dropped.

23. ECOLOGICAL IMPACTS, SUPERVISORY AND COMPUTER CENTER

Multiple and frequent testing, distributed geographically over the entire project area from The Post Canal to Catoosa, is involved in this area of investigation. It would seem advisable, then, to organize the research by geographic units, under central supervision.

For Arkansas, the four subregions designated by the Arkansas Planning Commission would seem to be a recommended division of area and labor. For Oklahoma, the logical division of the river is upstream from the Arkansas border to Muskogee, then the stretch to Catoosa. For tributary and reservoir studies, the counties should be divided:

Eastern Subregion	Western Subregion
Leflore	Tulsa
Haskell	Rogers
Sequoyah	Creek
Muskogee	Osage
Wagoner	Pawnee
Cherokee	Washington
Adair	Hayes
Latimer	Okmulgee
McIntosh	

Thus, there would be six ecological survey centers, each responsible for collection and maintenance of data at the various testing stations and sampling sites indicated in the text within the counties of its jurisdiction. Records would be kept at the subregional centers and copies forwarded to a central office at WRI for compilation on tapes and subsequent analysis.

The immediately following recommendations apply to the central office at WRI or other CE facility.

Staffing:

One senior biologist; one field assistant biologist; one computer programmer; adequate clerical staff.

Timing:

Continuous

24. TOTAL WATER QUALITY SURVEYS, MAINSTREAM, TRIBUTARIES AND RESERVOIRS

The tests, at various sites recommended in the text, encompass 4 physical, 11 chemical and 1 biological tests to be made weekly; 4 biological tests to be made monthly; and 1 biological test to be made annually. The data are to be recorded in a number of graphic profiles. The physical and chemical tests are simple in nature and may be rapidly taken, while the biological tests, supporting the maintenance of species diversity indices in several categories, are more complex.

In view of these factors, it is felt that one full-time journeyman biologist at each of the six subregional centers can perform the tests and maintain the records, both on the mainstream and the tributaries, assuming that he is assisted in taking the monthly biological tests by the traveling field biologist attached to the supervisory office at research headquarters. The field biologist will direct these studies as well as assist in the data collection. Assistance of state Fish and Game personnel is further predicated for the fish population surveys of tributary streams.

Staffing:

Six journeymen biologists, full-time, one at each subregional center for ecological data collection.

Timing:

Continuous, for the life of the research project.

25. BANK VEGETATION AND WILDLIFE SURVEY

The research involves a winter time survey of vegetation at selected sampling sites, with annual replication surveys at the most promising of the sites. From these findings, a highly specialized zoologist is able to extrapolate, with greater accuracy than is possible from a population count, the numbers and species of game supported per acre. A calculation is then made of the total number of similar acres along the streams of the basin project, yeilding a figure of the total game population supported by this habitat.

Staffing:

All personnel to be hired on a consultant basis. The initial vegetation survey to utilize two botanists and a surveyor; replication surveys, one botanist and one surveyor. Extrapolation of game populations to be performed by two or more zoologists with a high degree of local expertise. Sampling sites to be selected in conference, with all personnel involved attending, conducted by senior biologist in charge of ecological headquarter center.

Timing:

One large-scale winter survey at a number of sampling sites, followed by annual winter time replication surveys at a few of the same sites.

26. BOTTOMLANDS: TESTS TO DETERMINE PURGATIVE CAPABILITY OF RIVER SWAMPS

The field testing involves taking sample readings of physical and chemical properties of river water at the point of entrance into the swamp and again at point of exit.

At the ecological center, data from the tests would be used to calculate the cleansing capability of the sample swamp in gallons of pollutants per acre of swamp. From this, total purgative capability of swamplands lost by project inundation can be calculated, and this capacity in turn can be converted into dollar value of equivalent sewage treatment plant investment and maintenance.

Staffing:

No additional staffing required. Tests of water quality are simple and quickly done, hence can be added to workload of full-time biologists assigned to water quality testing. Extrapolation to be done by ecological center staff.

Timing:

Testing at sample sites to be done monthly from April through November.

Cost:

Minimal--materials, plus time of permanent staff.

27. COMPUTERIZED TIME SERIES STUDY OF RIVER SWAMP PRODUCTIVITY

This study, like the one preceding, is essentially an investigation into the ecological costs of economic growth based on water resource development. It is directed to the determination of the effect, presumptively deteriorative, of alteration from the natural water level fluctuations of river swamps in the basin on their biologic productivity. For inundated or drained swamp acreage, it is, of course, a measure of sheer loss. Annual surveys of at least two sampling sites, of approximately 100 acres each, are proposed--one in the delta region, one at least 200 miles upstream. Programming and analysis of data would be conducted at the research effort's ecology center.

Staffing:

For the field work, two botanists and a surveyor on _per diem_ hire, for two to four days each year (clearly, this work might well be integrated with the proposed survey of bank vegetation, also employing two botanists and a surveyor). For the programming and analysis, the permanent ecology center staff should make maximum use of the uniquely qualified Mr. Franz as consultant.

Timing:

Annual surveys at two sites for at least 20 years. Computer program would include detail of hydrologic regime for each year at sampling site.

Cost:

About $25,000 per year.

28. FAUNAL SURVEY OF BOTTOMLANDS

This study, expressing ecological cost of development in terms of fish and game populations, should be closely coordinated with the foregoing investigation of effects on the biologic environment of bottomlands. The same sampling sites should be used, and estimating techniques similar to those developed by Dr. Eugene Hester and described in the text should be employed.

Staffing:

At each site, the half-time work of two zoology or biology graduate students is proposed. The work might provide the basis for doctoral dissertations.

Timing:

A three year study, involving two years of data collection and one year of analysis, is contemplated. With the findings--correlated with the findings of the hydrologic-botanical study previously described--as baseline, it should then be possible to estimate faunal capability of the sample site from the ongoing botanical data alone, since food-chain relationships would have been established. Since little cost is involved in these studies, it might be well to check at five year intervals to determine the actual correlation between floral and faunal survival and reproductive rates.

Cost:

About $50,000 for three years.

APPENDIX A

LEGISLATIVE HISTORY OF ARKANSAS RIVER DEVELOPMENT

Attempts at improving the Arkansas River have a long history, as does the current project now about completed. As noted earlier, the first project for the improvement of the Arkansas River was authorized by the River and Harbor Act of 1832. Under that act, operations on the river consisted of removing obstructions and constructing temporary dams to remove sand bars between Fort Smith and the mouth of the River. Various Federal projects were enacted over the course of the next century. In the River and Harbor Act of 1886 a channel at least 200 feet wide and 6 feet deep between Little Rock and the mouth was contemplated. Local interests have made channel improvements from time to time, usually to protect lands along the river from loss by bank caving, but not really for the purpose of improving the river for navigation.

In the past 50 years, Congressional action on river development seems to have frequently been of a remedial rather than a preventive nature. A flurry of speeches and bills dealing with flood control have always followed upon the heels of floods on one or more of the nation's rivers, but the enthusiasm usually was short lived. A great flood in 1912 caused the government to become concerned with river improvement and flood control, rather than simply navigation. $285 thousand was allocated for the improvement of the Arkansas in 1913, but the outbreak of World War I caused a large cut in the appropriations, and after the War national interest died out. In 1927, another severe flood led to a plan for a system of permanent flood control measures in the Flood Control Act of 1928. But the stock market crash of 1929 and the depression crushed this plan. Severe flooding occurred again in both 1936 and 1937. The outbreak of World War II halted work on civil works projects proposed as a result of these floods.

To trace the events leading up to the approval of the current Arkansas River multiple purpose project, we begin with approval of the navigation plan in 1946 working forward and to some extent backward from that date. The first comprehensive survey of the Arkansas River and its tributaries (House Document No. 308, 74th Congress, 1st session), was submitted to Congress in 1935. House Doc. No. 308, in turn, was authorized primarily by three pieces of legislation--the Flood Control Acts of May 31, 1924, January 21, 1927, and May 15, 1928.

The first of these three acts authorized the Secretary of War to cause preliminary examinations to be made of various streams with a view to the control of their floods. Among the streams were the Canadian River in New Mexico, Texas and Oklahoma; the Verdigris in Oklahoma, and the Arkansas River in Kansas, Oklahoma and Arkansas.

A preliminary examination as well as a survey were authorized and directed to be carried out by the Secretary of War on the Arkansas and its tributaries in Arkansas and Oklahoma by the 1927 act.

The act of May 15, 1928, urged that the surveys authorized by the 1927 act be completed as speedily as practicable. This included the survey of the Arkansas River. The reports made pursuant to the 1928 act, moreover, were to include estimates of the effects on the areas surveyed of further flood control on the lower Mississippi River which was to be attained through the control of flood waters in the drainage basins of the tributaries by the establishment of a reservoir system. $5 million was authorized for these studies, in addition to amounts previously authorized by the 1927 act.

While the results of these authorizations were being awaited, the efforts of Congressmen from the districts around the Arkansas to obtain Federal funds for improvement of the river continued. In the 71st Congress, Congressman Hastings of Oklahoma (Tahlequah) introduced a bill that would appropriate $20 million for improving the Arkansas from the Mississippi River to Tulsa, Oklahoma, to restore navigation on the river from Tulsa to its mouth. Hastings assured his fellow House members that the awaited report of the Army Corps of Engineers (i.e., Doc. No. 308) would assuredly give a favorable recommendation to such a navigation project, and that the appropriation would merely facilitate and expedite matters. While Doc. 308 was being awaited, bills were introduced in every session of Congress providing for navigation improvement projects on the Arkansas from Tulsa to the mouth of the river. None of these bills was acted upon, including the Hastings bill.

The comprehensive survey of the Arkansas River and its tributaries contained in Doc. 308 was originally to be reported in the fall of 1930, but it was delayed over a year, and after the review by the division engineer, the Chief of Engineers and the Board of Engineers for Rivers and Harbors, it did not reach the Congress until July of 1935. The recommendations included with the survey advised against the construction of a navigation channel on the Arkansas River at that time. In the district engineer's report on the survey, which he submitted in 1932, he stated that it would be impossible to improve the river for navigation by dredging alone.[1] The insufficient flow of the river could be remedied by the regulated release of stored waters,

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[1] House Document No. 308, 74th Congress, 1st session.

but the shifting channels and caving banks would remain as serious obstacles. He recommended that "probably the best plan of improvement on this river is by complete canalization, which, it is indicated, will offer the more dependable navigation if accompanied by extensive maintenance".[1] The cost to provide such a plan for navigation was deemed to be economically unjustifiable.

Actually, two alternative plans and two alternative routes were considered in this document. Although a nine-foot channel was the primary focus of the navigation study, the possibility of a six-foot channel was also investigated. Routes were considered to both Tulsa and to Catoosa, Oklahoma. The project cost (for navigation alone) for canalization to Catoosa was estimated to be $204 million. To Tulsa it would be $270 million. The total comprehensive project cost was estimated to be $468 million to Catoosa, and $611 million to Tulsa. The annual savings in freight rates were estimated to be $10,220,000, but the annual charges for the project, depending on the route, were from 1.8 to 2.3 times the annual freight savings. The benefit-cost ratio was estimated to be about .6 to 1.0 for the navigation project. A total of 40 locks and dams were thought to be required for the route to Catoosa. The plan to Tulsa would have required 14 additional locks. A commerce of 7.5 million tons was assumed in estimating the savings. There was unanimity among the district engineer, division engineer, Mississippi River Commission, the Board of Engineers for Rivers and Harbors and the Chief of Engineers against the navigation plan. However, some aspects of this comprehensive survey document were acknowledged by the Corps to be worthwhile, particularly some of the flood control features.

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[1] *Op. cit.*, p. 219.

So the recommendations of the Corps of Engineers, while they resulted in at least a temporary defeat for the development of the Arkansas River for navigation, did not rule out all the projects in the document. In the next three years, in response to the recommendations of the Corps, Congress was to authorize most of the flood control projects in the comprehensive plan contained in Doc. No. 308. At the same time, the navigation project was revived, because in the same session of the Congress (79th, 1st session) that saw the submission of House Doc. No. 308, other legislation was put in the hopper which culminated in another comprehensive survey document (House Document No. 758, 79th Congress, 2nd session) on the Arkansas River and tributaries. This later document received more favorable treatment at the hands of the Corps of Engineers, and was to serve later as the basic authorizing study for the current multiple purpose project.

It is important to point out and emphasize the distinction between the flood control and the navigation aspects of House Document No. 308. The reason for doing so is that, although we are primarily concerned with the present multiple purpose project on the Arkansas River which is first of all a navigation project (although it does have other features as well), there is a clear distinction between the navigation project on the Arkansas River and the comprehensive development of the river for flood control. This distinction becomes important primarily for three reasons. First, the comprehensive flood control plan was approved by Congress in 1938, eight years before the multiple purpose navigation project. Second, Congress for several years passed separate authorizations for the navigation project (and its other features) and the comprehensive flood control project, then later combined the plans into one.

The projects are still thought of as distinct, however. The third reason that the distinction is important is that three of the reservoirs that are part of the comprehensive flood control plan (Eufaula, Keystone, and Oologah) are also included in the multiple purpose plan for navigation. Thus the two plans are separate but overlapping. The costs of Eufaula, Keystone and Oolagah, although they contribute to the overall flood control program, are allocated to the navigation (multiple purpose) project.

Thus, to distinguish between these two phases of the development of the Arkansas River, it will be useful to regard the flood control plan approved by Congress in 1938 as the general comprehensive plan for flood control, and the plan authorized by Congress in 1946 as the multiple purpose project.

As noted above, in the same session of Congress that House Doc. 308 was submitted, further legislation went into the hopper which culminated in another survey of the river. This legislation consisted of two statutes, passed in consecutive sessions of the 74th Congress, although both were originally introduced in the first session. The first of these laws (Public Law No. 409, approved August 30, 1935) authorized and directed the Secretary of War to have preliminary examinations and surveys made of several localities, including the Arkansas River in Arkansas and Oklahoma. The provision for the Arkansas River in this authorization bill was attached by an amendment on the floor of the House of Representatives by the Chairman of the Rivers and Harbors Committee of the House, Congressman Joseph Mansfield of Texas.

In the following session of the 74th Congress, the Flood Control Act of 1936 (Public Law No. 738, approved June 22, 1936) was passed. This statute authorized a total of $300 million for flood control improvements. Its significance for the Askansas comprehensive plan was that it authorized the

Secretary of War to have preliminary examinations and surveys made in several localities in the Arkansas region. The localities that were mentioned were the following reservoirs: Eufaula, Pensacola, Markham Ferry, Fort Gibson, Tenkiller Ferry, Wister, Oologah and Mannford. These projects had been contained in the comprehensive flood control plan for the Arkansas in Doc. 308.

In addition to its various authorizations, the Flood Control Act of 1936 stipulated that local interests are required to furnish the lands, easements and rights-of-way for flood walls and for levees as well as for reservoirs. As it turned out, the local interests frequently could not raise the money necessary to fulfill their obligation, and consequently those improvements were not made. This feature of the Act was amended in the following Congress by the Flood Control Act of 1938 (Public Law 761, 75th Congress, 3rd session, approved June 28, 1938), which provided that the federal government would reimburse local interests for the costs of the lands, easements and rights-of-way.

By early 1938, at least some of the preliminary examinations that had been authorized by the 1936 act were completed. Reports on the Wister, Oologah and Mannford Reservoirs were submitted by early 1938. After the reports of the examinations were reviewed, the Chief of Engineers authorized the surveys to be undertaken. In the case of the Wister and Oologah Reservoirs, the surveys were authorized in early 1938, and the survey of Mannford was authorized in late 1939. But in June of 1938, just shortly after the surveys of Wister and Oologah had been authorized and well before the survey of Mannford was authorized, Congress passed the Flood Control Act of 1938 (Public Law 761, 75th Congress, 3rd session), which included actual authorizations for these three reservoirs. This statute is significant both for its content and its timing. It approved the entire general comprehensive plan for flood control in the Arkansas basin, as set forth in Flood Control Committee Doc. No. 1, (75th Congress, 1st session) and authorized $21 million for the construction of reservoirs for the initiation and partial completion of that plan. It is interesting to note that the comprehensive plan was approved before Congress had access to the results of at least three of the surveys on projects that were integral parts of the plan (i.e., Mannford, Oologah and Wister). One is led to conclude that perhaps the Congressional action was a result of considerations other than strict economic evaluation. The reservoirs to be constructed were to be selected and approved by the Chief of Engineers, but the authorization stipulated that the Canton Reservoir on the North Canadian River in Oklahoma had to be included. The reservoirs that were selected by the Chief of Engineers were Mannford, Oologah, Canton, Tenkiller Ferry, Wister, Blue Mountain, and Nimrod. One of the major arguments raised against the bill was that it infringed upon states rights because it did not recognize a need to gain the consent of the states before acquiring land from them that would benefit other states. But this portion of the bill stood and it was passed.

Thus the Flood Control Act of 1938 set in motion the comprehensive flood control plan on the Arkansas River. Around the same time that this act was being put through Congress, other developments were taking place. Three Congressional committees adopted resolutions requesting the Board of Engineers for Rivers and Harbors to review the reports contained in House Doc. No. 308. These resolutions were passed by the House Flood Control Committee and the Commerce and Rivers and Harbors Committees of the Senate. The House Committee requested a review regarding flood control on the Poteau River, and two Senate Committees were requesting reviews to determine the hydroelectric potentialities of the river. Investigations were authorized by the Chief of Engineers in late 1938 and early 1939 on the basis of these resolutions. Also in 1939, the preliminary examination of the Arkansas that was authorized by Public Law 409 in 1935 was submitted, and late that year the survey of the river was authorized. The investigations that were initiated under the committee resolutions and the survey were subsequently incorporated into one report (House Doc. No. 758, 79th Congress) which was to become the basic document for the navigation project on the Arkansas. But it was to be six more years before the document was ready for submission to Congress. In the meantime, efforts at improving the river continued.

In the Army civil functions appropriations bill for fiscal 1941, amendments were introduced to attempt to speed up the process of construction of flood control works on the Arkansas. In the House, Congressman Cartwright of Oklahoma proposed a speed-up on the Wister Reservoir, but the amendment failed. Another amendment offered by Senator Thomas (Oklahoma) came closer to being incorporated into the bill. Thomas' amendment provided for authorization of an additional $28 million for continuing construction of the comprehensive plan for flood control as authorized by the act of June 28, 1938. Thomas argued that the purpose was only to raise the authorization ceiling so that, in the future, appropriations could be passed for the projects already authorized. No new construction was contemplated. Although Senator Thomas held a powerful position in Congress, which no doubt enabled this amendment to gain approval in the Senate, he was certainly aware of the bias in the Congress against legislating in an appropriations bill. Since authorizations are within the sphere of the legislative committees, this amendment was considered by many to be out of place in an appropriations measure. Besides the inevitable argument about usurpation of legislative authority, several Senators and Representatives argued that the amendment was designed, in spite of the fact that it would not appropriate money, to put the Arkansas River projects in a favored position over the many other projects authorized by Congress that were still waiting on the shelf. Of course, the measure was favored by the delegates from the states of Arkansas and Oklahoma. After the bill passed the Senate, the House refused to agree to several Senate amendments, including Senator Thomas'. A conference was called, at which the Senate conferees were ordered to hold fast to the Thomas amendment and some others. The conference succeeded in arriving at some compromises, but neither house would yield on Senator Thomas' amendment. Finally, a second conference was requested at which the Senate conferees finally receded and the amendment for the Arkansas River project was dropped.

Representative Whittington of Mississippi, the Chairman of the House Flood Control Committee, had reassured the Senate that a substantial authorization for the Arkansas would be made in that session anyway. Indeed such an authorization was reported out of committee on May 7, 1940 (H.R. 9640), but was carried over into the next session of the Congress because international events (the fall of France) overtook consideration of it. The bill was re-introduced in the following (77th) Congress and was passed (Public Law 228). It recommended an additional authorization of $29 million for flood control in the Arkansas Basin, with the understanding that none of the authorization in the bill would be used for the construction of Oologah Dam and Reservoir on the Verdigris River. It also modified the general comprehensive plan for flood control approved in 1938 to include the reservoirs on the Grand River in Oklahoma and Missouri (Markham Ferry, Fort Gibson and Pensacola) and the reservoirs in the Verdigris River Basin (Fall River, Elk City, Toronto and Neodesha). Shortly after this authorization was passed, of course, the United States entered World War II, and the civil functions program of the Army was curtailed.

By the time the 76th Congress ended in late 1940, the surveys of the river authorized in 1935 and 1936 had not yet appeared, and there was still considerable desire in the area for development of navigation. In the opening session of the 77th Congress, bills were introduced into the Senate and House "to provide for the improvement of navigation and control of floods on the Arkansas, St. Francis, Red and White Rivers for the promotion of national defense and other purposes." These bills inaugurated the efforts in Congress to set up an Arkansas Valley Authority along the same lines as the TVA. The bills had the support of President Roosevelt and in fact, the plan was drafted at his direction. The justification given for the AVA--the promotion of national defense--was probably at that time the only rationale that could have succeeded, but these bills were not acted upon, then or in the next session.

In 1943 Senator McClellan of Arkansas proposed a bill to provide for construction, maintenance and operation of flood control and navigation improvements in the Arkansas and White River basins. The bill was offered as a measure to aid in postwar readjustment to provide work as well as the other purposes specified in the bill. It did not introduce any new projects or call for the setting up of any authority. Nothing came of McClellan's bill or an identical one introduced in the House by Wilbur Mills of Arkansas.

During the World War II period there seems to have been a substantial amount of local or regional editorial support for the idea of an Arkansas Valley Authority. Clarence Byrns, then the editor of Fort Smith's two daily newspapers and a man credited with having done a great deal to secure the approval of the multiple purpose project on the Arkansas River, was a supporter of the AVA legislation from the time it was first introduced. While the war continued, the survey document authorized by Congress in 1935 and by subsequent committee resolutions was completed but the process of review by the Chief of Engineers was not completed until the fall of 1945.

Around this time Mr. Byrns (and probably other local newspapers as well) began to oppose editorially the idea of an Arkansas Valley Authority. Of course, it is impossible to determine the motivation behind Mr. Byrns' turnabout, but it seems likely that he did it for a number of reasons. First, the Chief of Engineers, by the end of WWII, had finally approved a comprehensive navigation plan for the Arkansas River and its tributaries in Arkansas and Oklahoma. Second, the Corps of Engineers opposed the idea of an AVA and it was clear their interest would lag if the facilities were going to be turned over to an authority. The Arkansas legislature at this time also passed a joint resolution opposing an Arkansas Valley Authority and favoring the development by the Corps of Engineers.

Finally, in the second session of the 79th Congress, the survey of the Arkansas River, authorized ten years previously, and the recommendations made on it by the various reviewing groups as well, was submitted to Congress. This document (House Document No. 758, 79th Congress, 2nd session), serves as the primary basis for the entire multiple purpose plan for the improvement of the Arkansas River for navigation, flood control, electric power, irrigation, etc. The circumstances under which this document was approved and became the legal authorization for the Arkansas River project are interesting and worthy of mention.

The report of the board which did the survey contained in House Doc. 758 was submitted in December of 1943. The report of the Division Engineer on the survey was submitted in February of 1944. Both of these sources recommended the project favorably. The survey then went to the Board of Engineers for Rivers and Harbors for another critical review. Here it met with greater opposition, and the Rivers and Harbors Board came up with a mixed recommendation. It believed that the flood control measures were justified, but that costs of the navigation project would exceed the benefits. The Board had held hearings in May of 1945 to obtain data and views from interested parties. The railroads, as one might expect, opposed the project and claimed the benefits were overrated. Apparently the Rivers and Harbors Board agreed. Its report stated: "Accordingly, the Board recommends that the multiple purpose plan of improvement be adopted as a basis for the future development of the water resources of the Arkansas Valley, that the part of the plan involving flood control features be constructed to supplement existing projects and that construction of the navigation features be deferred until there is more definite assurance that the benefits will justify the expenditures.[1] Just a week after that report was submitted, the Chief of Engineers submitted Document No. 758 to the Secretary of War with his recommendation that the entire project be constructed. There was, therefore, not a unanimous recommendation by the Corps of Engineers about the navigation aspects of the project

[1]House Document 758, 79th Congress, 2nd session.

and the Bureau of the Budget also had some reservations about the plan.

A better understanding of this disagreement about the navigation aspects of the project might be gained by citing the economic justification mentioned in the survey document. Actually, three separate plans were considered. One plan contemplated a navigation project only, at a cost of $373 million, of which $28 million was for the already approved Mannford and Oologah Reservoirs. The evaluated benefits accruing to the navigation plan would consist of the annual savings in transportation charges and the revenue from the rental of a part of the lands acquired for the Taft and Eufaula Reservoirs, which were parts of the plan. Annual charges were estimated to be $19,545,000. The estimated annual savings in transportation charges (based on an estimated annual movement of 9,015,000 tons of commerce) were $19,606,000. This saving, together with the revenue from land rentals ($134,000) gave a total annual benefit of $19,740,000, or a B/C ratio of 1.01 for navigation.

A second plan included no navigation features and was primarily concerned with power development. Its cost was estimated to be $373 million of which $59 million was for already approved Oologah, Tenkiller Ferry, Markham Ferry and Fort Gibson Reservoirs. The annual costs of this plan were estimated at $15,472,700 and the annual benefits at $13,374,000. The resulting B/C ratio was .86 to 1, and the survey board concluded that this plan was not desirable (not because of the B/C ratio, however, but necessarily because well developed land would be inundated and extensive adjustments in the social and economic life of the region would be needed).

The third plan was a multiple purpose plan consisting of coordinated developments for navigation, hydroelectric power, flood control, recreation, etc. This plan provided for 27 locks anddams--3 on the Verdigris and 24 on the Arkansas. Included in the 24 would be Dardanelle, Ozark, Webbers Falls, and South Mountain Reservoirs which would be used for power development. Some of the 13 reservoirs had already been approved in 1938. The cost was estimated at $523 million, but $77 million was for features already approved. Actual new cost then was $446 million. For this plan, the annual benefits and costs of the navigation aspects are the same as for the navigation plan. But total annual costs for unapproved features were estimated at $24,397,900. Annual benefits would be $26,366,200, of which $20 million was for transportation savings, $913 thousand from flood control, $6 million from power and $261 thousand from land rentals. The overall B/C ratio was 1.08 to 1.

Table A-1

Total Estimated Cost for Multiple Purpose Arkansas River Navigation Project--Original (1946) Estimate

Navigation Locks and Dams	$215,145,000
Blackburn Dam and Reservoir	14,267,000
Mannford	17,635,000
Taft	20,325,000
Oologah	14,665,000
Markham Ferry	19,295,000
Fort Gibson	21,435,000
Webbers Falls	26,118,000
Tenkiller Ferry	14,500,000
Eufaula	54,395,000
Short Mountain	40,083,000
Ozark	23,941,000
Dardanelle	40,874,000
	$522,678,000

The Secretary of War submitted Document No. 758 to Congress on July 24, 1946, which, in addition to authorization of the multiple purpose plan, included authorization of $55 million to be appropriated for the initiation and partial completion of the project, mostly for the beginning of the Eufaula Reservoir. It (H.R. 6407) was approved and signed into law (Public Law 525, 79th Congress, 2nd session), by the President the same day that Document No. 758 was reaching the Congress. Thus the Congressional debate on the bill was conducted before one of the authorizing documents was formally submitted to Congress. Some members, perhaps those more concerned with the projects in the bill, were no doubt aware of the contents of the survey document. One of these, Congressman Monroney of Oklahoma, introduced an amendment on the floor to try to remove the entire Arkansas River authorization from the bill. Monroney's contention was that the $55 million authorization would mean a commitment to the eventual expenditure of $446 million the then estimated total cost. His objection was based on the fact that the Board of Engineers for Rivers and Harbors had voted against the navigations aspects of the plan. Other Representatives from the area, including Congressman Stigler of Oklahoma and Congressmen Harris and Cravens of Arkansas opposed the amendment. Monroney was chided by Cravens for being against the project simply because it would do nothing for Monroney's constituency (Oklahoma City). Monroney's amendment was unsuccessful.

At the same time that Congress passed the bill including the Arkansas multiple purpose development plan, it authorized, in Public Law 526, 79th Congress (Flood Control Act of 1946) $40 million to be appropriated for the prosecution of the comprehensive flood control plan. This law was passed the same day as the authorization of the multiple purpose project.

Although $55 million was authorized by the 1946 River and Harbor Act for the multiple purpose plan, no money for construction had actually been appropriated. In 1948, the authorization for the navigation plan was increased by one million dollars and the plan was modified slightly, but no construction was started.

In 1950 Congress finally appropriated $1.1 million for construction of the navigation project for work on the Dardanelle Reservoir in Arkansas, and in the second session of the 81st Congress, H.R. 5742 was passed as Public Law 516. This was anauthorization for the construction and repair of public works, and it was a significant stage in the development of the multiple purpose project. This act authorized funds for both the general comprehensive plan for flood control and the multiple purpose project. $80 million was authorized for the multiple purpose plan, in addition to the money already authorized. $15 million was authorized for the comprehensive flood control plan.

In addition to the monetary authorizations, this act modified both the comprehensive flood control plan and the multiple purpose plan by the substitution of the Keystone Reservoir on the Arkansas River for the Mannford Reservoir on the Cimarron River, and by the deletion of the Blackburn and Taft Reservoirs on the Arkansas River. This modification was made in accordance with a recommendation made by the Chief of Engineers[1] at a cost of $37 million over and above what the deleted reservoirs would have cost and the authorization was increased by that amount.

Public Law 516 also authorized several preliminary examinations and surveys to be made. Included among those authorized was a study of the Arkansas, White and Red River basins in Arkansas, Louisiana, Oklahoma, Texas, New Mexico,

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[1]Senate Document 107, 81st Congress, 1st session.

Colorado, Kansas, and Missouri "with a view to developing comprehensive, integrated plans of improvement for navigation, flood control, domestic and municipal water supplies, reclamation and irrigation, development and utilization of hydroelectric power, conservation of soil, forest and fish and wildlife resources, and other beneficial development and utilization of water resources including such consideration of recreation uses, salinity, and sediment control, and pollution abatement as may be provided for under Federal policies and procedures, all to be coordinated with the Department of the Interior, the Department of Agriculture, the Federal Power Commission, other appropriate Federal agencies and with the states, as required by existing law."[1]

This authorization set up a committee (the Arkansas-White-Red River Basin Inter-Agency Committee--AWRBIAC) to perform the comprehensive survey authorized by that act. This study was carried out by the Corps during the period 1950-55 to determine its current justification. The AWRBIAC report was not a request for Congressional authorization, but was to provide Congress a framework within which to consider future recommendations. In making this review it became apparent to the Corps that certain projects had to be deferred for restudy. In 1954, a study was made of the navigation benefits on the Arkansas based on present and anticipated <u>future</u> benefits. The Chief of Engineers concluded that the project should no longer be deferred for future restudy, and that with modifications (which lowered the total cost from $1,247 million to $1,095 million) it should remain authorized, but that only bank stabilization and initial construction of Oologah Reservoir should be considered as part of the active program, since their benefits <u>without</u> the entire project would exceed costs.

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[1]Public Law 516, 81st Congress, 1st session.

The original 1946 report on the multiple purpose plan estimated that the navigation benefits barely exceeded cost with a B/C ratio for the navigation of only 1.01. Other aspects of the project brought the ratio up to 1.08, but apparently the marginal nature of the navigation plan was what motivated the Board of Engineers for Rivers and Harbors to recommend against its construction in the first place. At any rate, after the review of the project from 1953 to 1955, the estimated annual benefits from the project were raised from $23.6 million to $64 million, and the overall project B/C ratio was increased from 1.08 to 1 to 1.20 to 1. In these 1955 estimates, $40 million of the benefits would accure from the navigation project alone, based on an estimated 13 million tons of freight annually and a savings of $3per ton.

Expected annual benefits	
Navigation	$40 million
Flood Control	7
Hydro. Power	7
Channel Stab.	7
Water supply	3
	$64 million

Expected freight tonnage	
Petroleum products	3.8 million tons
Iron and steel	3.7
Coal	1.3
Wheat	0.6
Flour and feed	0.2
Less than barge lots	2.6
Misc.	0.8
	13.0 million tons

The project as modified (navigation only) would have a future estimated benefit-cost ratio of 1.15 to 1. But this was based on future economic development. The Chief of Engineers' (Gen. S. D. Sturgis) letter in 1955informing Congress that the Arkansas project was no longer deferred said, "While the ultimate economic feasibility of the plan appears to be established, the margin of the future net benefits over costs and the reliability of the estimates are insufficient to justify a commitment to construction of the plan as a whole in the immediate future. Certain parts of the plan can be constructed independently, since their benefits without the entire improvement would exceed their costs (bank stabilization and Oologah Reservoir). The timing for construction of other features will depend upon economic development and regional needs, at such time as immediate rather than future economic justification can be demonstrated in a re-evaluation report to be submitted to the Bureau of the Budget and to the Public Works Committees."

If the Corps had legal authority over approval of public works projects, the 1953-55 restudy of the Arkansas multiple purpose project might have meant another serious, perhaps fatal, setback to the project. But only the Congress can approve the expenditure of funds for public works and though the Chief of Engineers' recommendation did not help the project, it was not necessarily dead yet.

When the Chief's letter came out, and the Arkansas project was reactivated, the FY 1956 budget had already been submitted to Congress, with no money allocated for construction on the Arkansas. But the action of the Corps in reactivating the project, and perhaps impatience with the long delay since the original authorization nine years earlier, prompted interested members of Congress to try to do something about it. Congressman Edmondson of Oklahoma, with support from his colleagues from Arkansas and Oklahoma, amended on the floor of the House of Representatives the Army civil functions appropriations bill for fiscal 1956 to include $900,000 for the initiation of construction of two important reservoirs on the Arkansas project--the Dardanelle and Eufaula Reservoirs. The amendment was actually a substitute to an amendment offered by Representative Natcher of Kentucky. Natcher's amendment increased the appropriations for public works for 1956 by some $46 million over the amount approved by the Appropriations Committee. This was supposed to cover projects approved by the Corps of Engineers and the Bureau of the Budget but dropped by the Appropriations Committee. Edmondson's substitute amendment merely added $900,000 in appropriations to Natcher's proposal. The money was to be divided evenly between the Dardanelle and the Eufaula Reservoirs. Congressmen Albert and Hays also spoke in favor of the amendment and the projects. The amendment was approved and the bill was passed by the House.

The Senate Appropriations Committee, in its consideration of the bill, retained the appropriations for the Dardanelle and Eufaula projects and, in its report to the whole Senate, added another $1,150,000 for the Oologah and Keystone Reservoirs. All of these items were retained in the report of the conference committee and the bill was passed by Congress and the President signed it into law. Despite the fact that he signed the bill, however, the President impounded the funds that had been allocated to the Arkansas project.

While this action by the Chief Executive had been employed during wartime on civil works projects, as one would expect, it caused a substantial uproar in Congress, especially after President Eisenhower's budget for FY 1957 had again not included any funds for construction of the Arkansas project.

The President's message explicitly excluded the Dardanelle, Eufaula and Keystone projects because they would commit the government to an eventual $1 billion program, which the Executive was not prepared to undertake. The President's action the previous year in impounding appropriated funds was not unprecedented, but it was thought to be mainly an emergency measure to be used only in wartime. It was not an action taken calmly by Congress even in wartime, much less so during a period of peace. So, predictably, in response to the President's action, Congressman Edmondson, who had proposed the amendment that appropriated the money, took the floor of the House of Representatives for an hour and charged the Bureau of the Budget with usurping Congressional authority and questioned the constitutionality of the President's action. Several colleagues of Edmondson concurred with him or added similar remarks of their own for the Record.

Despite the fact that nothing was included in the Executive budget for the Arkansas reservoirs, Congressman Albert of Oklahoma, the Majority Whip of the House, testified in the hearings on the Public Works Appropriations Bill that spokesmen for the Bureau of the Budget had assured him that the Executive would now accept as a directive any new appropriation voted by Congress for this program. The railroads, of course, were still opposing the project as economically unsound. Despite the lack of budgeted funds for FY 1957, the Congress, determined to have its way, voted $500,000 each for the Eufaula and the Dardanelle Reservoirs for initiation of construction.

So, after considerable delay and some controversy, the multiple purpose Arkansas River project finally began to get rolling in fiscal 1957. Construction on three of the major projects--Eufaula, Keystone and Dardanelle--all began in that fiscal year. Construction was initiated on the Eufaula Reservoir in December of 1956, on Keystone in January of 1957, and on Dardanelle in June of 1957. Oologah Reservoir (part of the comprehensive flood control plan but also considered a feature of the navigation plan), which had been started earlier and then held up, was also resumed. Dardanelle, Keystone and Eufaula needed to be completed around the same time for them to be worthwhile, according to the Engineers and spokesmen for the project.

Although Congress acted to get the project rolling (despite the Chief Executive's policy of "no new starts" on public works projects), the controversy over the method used in approving it and the economic feasibility of the project did not end. The railroads continued to oppose the construction of the project, and supported their contention with the statements made by General Sturgis in his 1955 letter reactivating the project. Three years after Congress had initiated appropriations for the Arkansas, Chairman Clarence Cannon of Missouri also cited the letter of General Sturgis in the Public Works Appropriations Subcommittee of the House. He inquired of General Whipple of the Corps of Engineers whether anything had transpired since 1955 to change the Corps' decision on the project, "other than appropriations which the Congress has made to prematurely start some of the features of the project." Cannon stated, "We have made some appropriations, the advisability of which I doubt, as they were really in anticipation of the conclusion which the survey did not eventually justify." In his reply to Chairman Cannon's questioning, General Whipple replied that the position of the Corps and the letter of General Sturgis were "overtaken by events" so the study to which Sturgis referred was never in fact formally made and presented to the Bureau of the Budget because of the action of Congress, which resulted in appropriations to initiate construction of several key features. Subsequently, the Corps made more intensive evaluations, Whipple said, and it was determined that the project would have a favorable benefit-cost ratio. This statement about the benefit-cost ratio was somewhat ironic since in this very same hearing (1959) General Whipple stated that the B/C ratio was being lowered from 1.2

to 1.1 for the entire lower Arkansas system due to an increase in channel work. This ratio was barely more than the marginal (1946) estimate of 1.08 to 1. The increased cost projected in 1959 raised the total for the project from $1.1 billion to $1.2 billion. Congressman Cannon, in these 1959 hearings, suggested that Eufaula and Dardanelle might be deferred until a general study by the Corps was complete. Despite protests by Whipple that delay would disrupt the engineering program, Cannon asked him to defer contracts until they (the Committee) had an opportunity to take action. Whipple admitted in questioning that none of the individual projects, except Oologah, could be justified by itself.

The opposition of Cannon and other members of the House Appropriations Subcommittee to the rapid pursuit of the Arkansas project did not seem to prevent the continuation of appropriations for Dardanelle and Eufaula. After the 1959 hearings, opposition to construction of the navigation project seemed to dwindle considerably. The revised total cost of the overall project as stated by General Whipple--$1,201,850,000--in the 1959 hearings was to remain remarkably stable throughout the next ten years, all the way up to the scheduled completion date of the navigation project, even though individual features of the project have experienced considerable fluctuations in cost. We will return to this point later.

Until 1960, funds were authorized for the comprehensive flood control plan and the multiple purpose plan for navigation separately. By the time construction began on the earliest phases of the multiple purpose project in late 1956 and in 1957, Congress had authorized since 1938 the spending of $140 million for the flood control plan, and had authorized $136 million for the multiple purpose plan since 1946.

Authorizations for Arkansas River Previous to 1960

Comprehensive Flood Control Plan		Multiple Purpose Plan	
1938 Flood Control Act Public Law 761, 75th Cong.	$21,000,000		
1941 Flood Control Act Public Law 228, 77th Cong.	29,000,000		
1944 Flood Control Act Public Law 534, 78th Cong.	35,000,000		
1946 Flood Control Act Public Law 526, 79th Cong.	40,000,000	1946 River and Harbor Act Public Law 525, 79th Cong.	$55,000,000
		1948 Flood Control Act Public Law 858, 80th Cong.	1,000,000
1950 Flood Control Act Public Law 516, 81st Cong.	15,000,000	1950 River and Harbor Act Public Law 516, 81st Cong.	80,000,000
	$140,000,000		$136,000,000

Note: $37,273,000 in additional costs for the Keystone Reservoir (since Keystone was integral to both plans) was also authorized, although this added cost has nearly doubled over time.

In the first session of the 86th Congress in 1959, a bill that would combine these two plans into one was introduced. This was H.R. 7634 (Public Law 645, 86th Congress, 2nd session), a public works authorization bill which provided $94 million in additional authorization for the Arkansas. Although the bill passed the House in 1959, it was delayed and carried over to the next session in 1960. According to the Senate report on the bill, the flood control plan and the multiple purpose plan were being constructed all along as a single coordinated plan of development. But the Corps had to maintain separate accounting records for the two plans because the monetary authorizations could not be combined due to the different types of Congressional authorities. The action, therefore, was for administrative purposes. The Senate also amended the House authorization for the Arkansas and added $85 million to the House total, for a grand total of $179 million in newly authorized funds. When the plans were combined, all the authorizations that had been passed by Congress before combining the two plans were made applicable to the combined plan. Thus the authorizations for the separate plans before 1960 were combined for a total of $276,000,000. The modification which put Keystone Reservoir into the plans brought the authorization to $313,273,000. When the $179 million authorized in 1960 were added to this total, the authorizations as of 1960 came to $492,273,000.

Although from this time forward the authorizations for the navigation plan and the flood control plan on the Arkansas were combined, the costs of the navigation plan were and have been kept separate from that for the reservoirs in the flood control plan (except for Eufaula, Keystone and Oologah, which are charged to the navigation plan).

In the 1960 appropriations hearings on the Arkansas project, the witnesses appearing before the Appropriations Committee were concerned mainly that the emergency bank stabilization program be changed to a permanent basis. This bank stabilization had been operating even before the reactivation of the project in 1955. It had been estimated to cost $25,286,000. In 1958, Congress appropriated the last of that amount and after FY 1959, there was no balance left to continue stabilization. By 1960, however, the estimated Federal cost had been raised to $37,103,000 and appropriations continued.

Witnesses for the project urged that it be made a permanent program, and they apparently succeeded, for the following year's hearings (1961) on the President's budget, bank stabilization and channel rectification were no longer emergency programs. What is more, the estimated Federal cost of the stabilization aspects of the project had been raised again--this time from $37 million to a sizeable $118 million.

An interesting facet of this $81 million increase, from 1960 to 1961, in the estimated cost of bank stabilization is that the overall project cost remained exactly the same--$1,201,850,000. One fact that might explain this is that some changes had been made in the Arkansas plan. According to General Whipple, the dams were to be spaced farther apart and only 19 dams rather than 24 or some larger number would be required. On the other hand, the following year (1961) in hearings before the House Public Works Appropriations Subcommittee, the Corps' testimony stated that four moredams had been knocked out of the project design, bringing the total number of navigation locks and dams down to 15, without a comparable reduction in project cost. Tables showing the annual cost estimates, budget estimates and appropriations are included in Appendix C. The estimated cost remained at $1,201,850,000.

In the 1962 hearings on the Arkansas, the benefit-cost ratio was listed, instead of simply as 1.1, as 1.1 for a project life of 50 years, and 1.3 to 1 for a project life of 100 years, and between 1962 and 1965, the B/C ratio was raised to 1.4. After 1965 it was increased further to 1.5 to 1. This increase in the ratio in part is due to continually enhanced estimates of annual benefits. The 1955 estimate of $64 million in annual benefits remained fairly firm until about 1964. Below are three sets of benefit estimates that increased this amount:

1964			1967	1970
Trans. savings	$40.5 million	Navigation	$40,470,000	$40,470,000
		Channel Stab.	6,575,000	6,575,000
Power	11.0	Power	14,838,000	14,838,900
Flood Control	6.5	Flood Control	6,602,600	6,602,600
		Water Supply	828,900	828,900
		Fish & Wildlife	312,000	312,000
		Recreation	2,297,000	2,297,000
		Development		3,355,800
Other	8.0			
Total	$66.0 million	Total	$71,923,500	$75,280,200

The progress of the project continued uninterrupted once the opposition of certain members of the Appropriations Committee (e.g. Reps. Cannon and Pillion) subsided. Further substantial authorizations were voted for the Arkansas project in subsequent years. Only in 1964 was the President's budget request below the project advocates' expectations, and only by about 15 percent. Witnesses for the project stressed the increased costs that would result if the project were not completed by 1970. They also emphasized the tremendous economic benefits they felt would accrue to their depressed area as a result of the project's completion. One advocate, Senator Monroney, stated, "The only solution to low median family income, high rates of unemployment, high welfare costs, deteriorating farm income, low Federal and State tax income, and problems of health, education and poverty is the completion of the project, as scheduled, by 1970." Senator Monroney, it may be recalled, was the then Congressman who attempted to knock the Arkansas project out of the public works authorization bill in 1946.

In every fiscal year from 1965 through 1969, the Executive budget allocated $100,000,000 or more to the Arkansas project. In FY 1967 and FY 1968, these sums reached over $150,000,000. During 1969 in hearings on the FY 1970 budget, the project was still on schedule for navigation to Catoosa by calendar year 1970, and that goal has been realized. Only minor completing aspects remain and these should be finished in fiscal year 1971.

APPENDIX B

SOME INFLUENTIAL PROMOTERS OF THE ARDP

The idea of navigation for the Arkansas River has been promoted for many years going back well beyond the origins of the current projects. Our interest here is in the more contemporary influentials--those whose influence has been most pronounced or at least has been perceived to be the most important in actually obtaining navigation on the Arkansas.

A case probably could be made for the argument that the public arena--especially members of Congress--is the crucial locus of influence in the authorization of public works projects. The methods of the Congress in passing legislation of this kind have led to the coinage of such unique terms as "pork-barrel" and "logrolling". Public works, of course, is not the only policy area in which the technique of "distributive policy-making" (to put it more elegantly) is found. Any policy which involves the disaggregation and distribution of goods across a number of geographic units (counties, constituencies, states, etc.) invites such a technique. The awarding of national defense contracts is another common example. Our purpose is not to comment on these techniques but merely to point out that Congressmen are in a unique position to effect the authorization of a public works project. Not only are they in a position to do so, but most Representatives and Senators feel that such tangible results of legislative activity are helpful in convincing voters of the value of their service as representatives.

On the other hand, the process by which river improvements are enacted into law is supposed to begin with private citizens. They contact their Representative about a desired improvement, and only after private initiative has been shown does a Congressman or Senator enter the picture. Presumably the Congressman or Senator cannot be informed about all such needs unless informed by his constituents, and this is probably true.

It would seem then that the identification solely of legislators or solely of private citizens thought to be influential in public works legislation would be inadequate. This appendix tries to identify both private citizens as well as Congressmen whose influence in bringing navigation to the Arkansas River was particularly notable. In the following pages these individuals are discussed, as is the opposition to the project over the years.

The names of three men have been consistently mentioned as private citizens who deserve the lion's share of the credit for their tireless effort in promoting navigation on the Arkansas River and in finally realizing their goal. None of these three men are alive today. The first of these men was Clarence F. Byrns of Fort Smith, Arkansas. Mr. Byrns was a newspaperman all his adult life and was the editor of Fort Smith's two daily newspapers. Mr. Byrn's efforts on behalf of navigation easily spanned a generation. The second man was Reece Caudle, an attorney of Russellville, Arkansas. Caudle was also an Arkansas state legislator, was once Speaker of the Arkansas House of Representatives, and for four years was President of the state's Soil Conservation Service District Supervisors Association. Caudle was both executive secretary and president of the Arkansas Basin Association. The third man was Newton R. Graham of Tulsa, Oklahoma. Like Mr. Byrns, Mr. Graham was at one time a newspaperman, as well as a representative for the Exchange National Bank of Tulsa. He was also with Tulsa Chamber of Commerce.

We will make no attempt to rank these men in importance, but it seems that Mr. Byrns was more than any other private citizen identified with the navigation project. Perhaps this was due to his access to a channel of mass communication and his frequent use of his newspapers to promote navigation on the Arkansas.

It is probably in part due to his appearance every year for several years in Washington to speak to Congressional committees as chairman of the Bi-State and Tri-State Committees (discussed below) which were lobbying for appropriations. Byrns, Caudle and Graham were all active as far back as the 1920's in promoting the idea of navigation on the Arkansas River, in fact when most people were still skeptical that such an engineering feat could be achieved at all, much less being economically feasible.

In 1927, Graham was appointed to the Waterways Committee of the Tulsa Chamber of Commerce (known then as the Tulsa Commercial Club). Charles Gannaway, currently Chairman of the Board of the Arkansas Basin Development Association has said that this appointment of Graham was "probably the most important move that took place in the long fight to make the Arkansas River navigable..."[1] From this date Graham was a booster of the project for thirty years. An example of Graham's active influence in promoting the improvement of the river occurred in the middle 1930's. This was around the time when the surveys of the Arkansas authorized in 1927 and 1928 were being completed and prepared for submission to Congress. In 1934, according to Gannaway, "a consulting engineer employed by Tulsans submitted a report to the Board of River (sic) and Harbors in Washington that presumably supported a navigation project on the river. The Tulsans were rebuffed."[2] In addition to this rebuff, interested parties from Arkansas and Oklahoma were no doubt aware that the surveys authorized in 1927 and 1928 which culminated in House Doc. No. 308, 74th Congress recommended against a navigation channel for the Arkansas. According to representatives of the Arkansas Basin

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[1] Speech before the Oklahoma Historical Society, June 12, 1970.

[2] Ibid.

Development Association--Colonel Harley Ladd and Mr. Charles Border--Graham was a personal friend of General Markham, at that time the Chief of Engineers of the U.S. Army. Graham succeeded in persuading Markham to agree to review all previous reports on the Arkansas River. Markham set up a team to perform this task--the Arkansas River Survey Board. Legislation in 1935 authorized a re-survey. Colonel Francis J. Wilson of the Corps of Engineers, who headed this board, submitted the report which became House Document No. 758, 79th Congress, the document authorizing the navigation project now nearing completion. Colonel Wilson later became Executive Vice President of the Arkansas Basin Development Association in Tulsa, Oklahoma, an organization that has promoted the project since 1946, when Colonel Wilson's report was submitted to Congress. Recently the City of Tulsa-Rogers County Port Authority and the Oklahoma legislature passed resolutions to name Lock and Dam No. 18 on the Verdigris River the Newton R. Graham Lock and Dam.

Besides his long effort in propagating the idea of navigation on the Arkansas River through his newspapers, Clarence Byrns was instrumental in the formation of the primary lobbying group representing the Arkansas River states before Congress. In 1943, the Arkansas River basin experienced one of the worst floods, if not the worst, in its history. At this time Ben Laney was Governor of Arkansas. According to Jeta Taylor, an attorney from Ozark, Arkansas, who knew Byrns and who himself was influential, Byrns was fairly close to Governor Laney, and is reported to have been instrumental in convincing Laney and the Governor of Oklahoma, Robert S. Kerr, to cooperate in forming a two-state water resources committee. This Arkansas-Oklahoma Bi-State Committee was formed in 1945. Three men from each state were appointed by the two governors. Byrns, Caudle and

Graham were three of the six appointed. The other Oklahoma appointees were Elmer Harbour, a merchant from Muskogee and Don McBride, who later became Kerr's assistant when he went to the U.S. Senate and is now a commissioner of the TVA. Arkansas' other appointee was J. C. Murray, a freight rate expert with the Little Rock Chamber of Commerce. The Bi-State Committee became the chief lobbying organization for the Arkansas River development, and every year its members, along with many individuals from the Arkansas Basin Association (Arkansas) and the Arkansas Basin Development Association (Oklahoma), went to Washington to speak on behalf of the two states. Mr. Byrns, who was Chairman of the committee for many years, was usually the main spokesman, while most of the others would submit only written statement. Kansas joined the committee in 1957 and in December of 1969, Colorado made it the four state committee. Now each state sends five representatives. Such cooperation has probably aided in the drive for appropriations, since the Congressional delegations of a number of states will normally be more effective working as a unit than just one state's delegation.

Other influential private citizens could and should be mentioned in addition to the three already discussed, but not all can be included. In addition to Byrns, Caudle and Graham, two other notable individuals (who are both still living) are Glade Kirkpatrick of Tulsa, Oklahoma, and Jeta Taylor of Ozark, Arkansas. Mr. Kirkpatrick is President of the Guaranty Abstract Co. in Tulsa and took over as Chairman of the Tri-State Committee and spokesman for the Arkansas project after Clarence Byrns died. Mr. Taylor is an attorney, a Director of the ABDA and has appeared for many years before Congress on behalf of the project. He has served as chairman of the Arkansas delegation on the Tri-State (now Four-State) Committee.

When the Arkansas River basin experienced the disastrous flood of 1943, the Governor of Oklahoma, Robert S. Kerr, was flown by Colonel F. J. Wilson over the affected areas, and he became determined to do something about it. Whether or not this was any kind of turning point in Kerr's attitude, it is clear that he was thereafter a very staunch promoter of the development of the river. Kerr, as a public figure, became more identified with the Arkansas navigation project than even Clarence Byrns. Kerr, above all other elected officials, was the man behind the Arkansas navigation project. He was Governor of Oklahoma from 1944 to 1948. The project was authorized while he was governor. Kerr was elected to the Senate in 1948 and spent 14 years there until his death January 1, 1963. During his tenure he accumulated enough seniority to become chairman of the Flood Control and Rivers and Harbors Subcommittee of the Senate Public Works Committee. Needless to say, this put him in a position of substantial power _vis a vis_ public works projects. And Kerr was known to friends and critics alike as a shrewd, sometimes ruthless trader. He was in a position to accumulate debts by inserting his colleagues' pet projects into bills in Committee. And his reputation was that he did not hesitate to cash these debts in. By the time Kerr died, the Arkansas navigation project was well on its way and getting more than its share of the funds in the Army Corps of Engineers budget.

Kerr was the acknowledged leader in Congress of the Arkansas project. When he died, officers of the Arkansas Basin Association of Arkansas Basin Development Association went to Senator John McClellan of Arkansas and asked him to take over Kerr's advocate role. McClellan had been involved all along, since the project was first authorized. As Chairman of the subcommittee on the Departments of State, Justice and Commerce of the Senate Appropriations Committee (where he now ranks 3rd in seniority), he had a great deal of influence. When asked to play the leading role on the project, he accepted. Since Kerr's death, McClellan has spearheaded the drive for appropriations. In 1964, when President Johnson attempted to hold down spending due to the increased costs of the Vietnam War, the Bureau of the Budget requested $84 million for the Arkansas, $15 million less than the Corps' own request. Members of the Tri-State Committee implored Congress to keep the project on schedule by appropriating the full $99 million. Although Congress passed only $84 million on the first appropriation, McClellan was instrumental in persuading Johnson to submit a supplemental request of $15 million to keep the project on schedule. Since then the Corps has gotten virtually all of the funds it has requested for the Arkansas project.

The names of several other influential individuals besides Kerr and McClellan are mentioned by promoters of the project, going back as far as the 1930's. In the House there were Representative David D. Terry of Little Rock, Representative James Trimble (also from Arkansas), and Representatives Ed Edmondson and Page Belcher of Oklahoma. In the Senate, two individuals from Oklahoma stand out--Senator Elmer Thomas before 1950 and Senator A. S. Monroney since 1950.

Representative Trimble of Arkansas was a long time advocate of river development on the Arkansas. Trimble rose to a position of influence on the vital Rules Committee of the House before he was defeated in the 1966 election. He helped secure passage of the 1946 act along with the monetary authorizations it included. Representative Terry was not in Congress as long as most of the other individuals mentioned here, but he is given a great deal of credit for moving the project forward. Lock and Dam No. 6 on the river have been named in his honor. Terry was one of the founders of the Arkansas Basin Association, along with

Bryns, Caudle and Murray.

Representative Ed Edmondson must rank highly as a booster of navigation. The river runs right through his district. After the project went through its most critical stage in the early 1950's when it was being restudied, Edmondson proposed an amendment on the floor of the House to obtain money for construction. His amendment was passed, but the money was impounded by the Bureau of the Budget. The following year, no money was budgeted for the Arkansas, and Edmondson took the floor of the House for one hour to criticize the Executive on its usurpation of Congressional authority. It was around this time that Representative Belcher, the only Republican in the Oklahoma Congressional delegation at that time, was asked by Senator Kerr to intercede with President Eisenhower to release the funds. Belcher, Kerr and McClellan all went to Eisenhower and the President reportedly relented and let it be known that, if Congress chose to appropriate money again, he would allow it. In this way, construction was launched. Every year Edmondson and Belcher have spoken before the appropriations committee to make sure the project stays on schedule.

Elmer Thomas was Chairman of the Senate Agriculture and Forestry Committee from 1945 until his defeat in 1950 and is reputed to have been as shrewd a trader as Robert Kerr. The start of some of the flood control projects in the 1930's is attributed to his influence. It is no secret that Senator Monroney, who succeeded to Thomas' Senate seat, was an early opponent of the Arkansas navigation project in the days when he was still a representative from Oklahoma City. In 1946, when Congress authorized the project, Monroney opposed it on the floor of the House. He introduced an amendment at that time to strike the entire project and the initial authorization for it from the bill. He was accused of not supporting the bill because the project would not benefit his own constituency as much as other areas. After he moved to the Senate, Monroney became a staunch advocate of the development of the river. Some promoters of the project consider Monroney's turnabout a "conversion" from his earlier days when he was a "small dam man" influenced by Oklahoma City interests who were promoters of the Soil Conservation Service's watershed program. It also seems probably, however, that Monroney's turnabout was due to the enlarged nature of his constituency upon his arrival in the Senate. In any case, he is looked upon as a strong and helpful supporter of river navigation while he was in the U. S. Senate.

Four other members of Congress are also cited by Charles Gannaway as being particularly helpful to the Arkansas project--the late Representative Kirwan of Ohio, Senators Ellender of Louisiana and Randolph of West Virginia, and Representative George Fallon of Maryland. These men all either held or currently hold positions of critical influence in public works programs.

Over the years the primary opposition to the development of Arkansas River navigation has come from the Association of American Railroads. Testimony on behalf of several railroads was given at the hearings on the fiscal 1957 and 1959 budgets. The railroads claimed that projected navigation benefits were inflated due in part to an inflated estimate of the tonnage that would travel on the river. When this testimony was given, the navigation project was still not funded to any extent. By the early 1960's, however, a substantial amount had been appropriated, and railroad opposition seemed to fade away. Opposition that was not apparent from the Congressional hearings but which nevertheless existed, according to Jeta Taylor, one of the backers of the project, came from the Arkansas Power and Light Co. as well as other private power companies.

Groups that have worked in behalf of the project include, of course, the Inter-State Committee (which now totals four states), the Arkansas Basin Association in Arkansas and the Arkansas Basin Development Association in Oklahoma. The latter two were founded in 1946, and the ABDA's first president was Newton Graham. He served continuously in that post until 1955. The ABDA was reorganized and incorporated in 1955 as a non-profit organization. Colonel Francis J. Wilson was appointed Executive Vice-President and served in that position until his retirement on December 31, 1968.

The Mississippi Valley Association has been a long time supporter of the Arkansas River project. Some of the leaders of the ABDA, such as Glade Kirkpatrick and Charles Gannaway, have been officers in the Mississippi Valley Association.

According to the Chief of the Public Affairs Office of the Army Engineers Little Rock District Headquarters, the American Waterway Operators has been the strongest lobbying group on behalf of Arkansas navigation. The membership of the AWO is made up of barge owners and users, who would naturally support navigation facilities.

APPENDIX C

CONGRESSIONAL AUTHORIZATIONS AND APPROPRIATIONS FOR THE ARDP

Table C-1

APPROPRIATION HISTORY - ARKANSAS RIVER AND TRIBUTARIES

(In Thousands $)

Projects	Alloc Thru FY 57	FY 58	FY 59	FY 60	FY 61	FY 62	FY 63	FY 64	FY 65	FY 66	FY 67	FY 68	FY 69	FY 70	FY 71
Keystone	2,219	1,875	6,990	9,524	20,089	28,190	20,290	12,344	6,300	5,600	4,395	3,278	1,553	0	0
Eufaula	2,685	2,735	6,450	7,900	20,261	29,488	29,922	17,275	4,076	106	100	214	0	25	0
Webbers Falls	0	0	0	0	0	74	302	496	2,875	6,125	10,600	12,765	12,800	9,950	11,579
R. S. Kerr	0	0	0	0	0	406	475	2,645	10,651	18,100	20,700	12,671	11,209	9,157	5,986
Ozark	0	0	0	0	0	298	300	313	1,150	9,925	11,710	11,570	10,285	9,200	11,708
Dardanelle	1,225	819	1,188	4,878	6,215	7,877	10,230	21,341	9,931	1,950	475	3,825	8,016	4,330	670
Oologah	4,666	4,800	9,100	11,045	3,428	1,587	1,195	525	260	73	550	872	3,120	3,375	267
Bank Stabilization	23,495	1,530	2,542	4,817	5,864	17,880	19,677	14,495	12,271	8,000	4,925	2,800	3,395	3,550	1,005
Navigation Locks	78	0	0	0	0	2,897	2,326	9,680	49,639	73,500	85,037	77,469	71,300	55,954	28,257
Navigation Aids (U.S. Coast Guard)	0	0	0	0	0	0	0	0	0	0	1,000	1,150	118	0	0
TOTAL	34,368	11,759	26,270	38,164	55,857	88,697	84,717	79,114	97,153	123,379	139,492	126,614	121,796	95,541	59,472 =
															$1,182,393

Source: Tulsa District Corps of Engineers.

Authorization for Arkansas Navigation Project

1938 Flood Control Act Public Law 761, 75th Cong.	$21,000,000
1941 Flood Control Act Public Law 228, 77th Cong.	29,000,000
1944 Flood Control Act Public Law 534, 78th Cong.	35,000,000
1946 Flood Control Act Public Law 526, 79th Cong.	40,000,000
1946 River and Harbor Act Public Law 525, 79th Cong.	55,000,000
1948 Flood Control Act Public Law 858, 80th Cong.	1,000,000
1950 River and Harbor Act Public Law 516, 81st Cong.	80,000,000
*1950 Flood Control Act Public Law 516, 81st Cong.	15,000,000
1960 Flood Control Act Public Law 645, 86th Cong.	179,000,000
1963 Flood Control Act Public Law 88-253	157,000,000
1965 Basin Authorization Act Public Law 89-42	290,000,000
1967 Basin Authorization Act Public Law 90-17	170,000,000
Subtotal	1,072,000,000
*Increased cost due to addition of Keystone Reservoir in 1950.	71,313,000
Total to 1968	$1,143,313,000

Arkansas River Multiple Purpose Navigation Project

	[1]Annual Budget Requests		[2]Annual Appropriations
FY 1956			$5,500,000
1957	$6,000,000		9,540,000
1958	18,400,000		13,590,000
1959	28,041,000		25,830,000
1960	41,800,000		37,375,000
1961	53,281,000		56,680,000
1962	82,859,000		86,893,000
1963	89,456,000		82,604,000
1964	85,155,000		78,489,000
1965	84,000,000		95,846,000
1966	136,300,000		123,230,000
1967	156,450,000		138,971,000
1968	155,029,000		126,686,000
1969	136,679,000		120,109,000
1970	96,046,000	Total thru FY 1969	$1,001,343,000
1971	55,219,000		

[1]The figures for annual budget requests are derived from the annual hearings before the Public Works Subcommittee of the House Appropriations Committee. They were obtained by totaling the requests for each of the individual projects in the overall plan. They correspond closely to the figures given verbally and periodically by witnesses for the project.

[2]It is difficult to come up with a stable set of figures for annual appropriations--the figures in the Chief of Engineers' Annual Report differ from the cumulative totals found in the Hearings, and still other figures appear occasionally in scattered places in the Congressional Record and authorization hearings. The totals presented here were derived again from the Hearings, by listing cumulative appropriations for the project which appear in the Hearings and working backwards to get the annual totals.

Annual Budget Requests and Appropriations for Separate Features of Arkansas River Navigation Project

1. Bank Stabilization and Channel Rectification
   Total Estimated Cost (1968) $133,000,000

	Budget Request	Appropriation	
FY 1956	$3,000,000	$3,500,000	
1957	3,000,000	2,980,000	
1958	1,300,000	1,430,000	
1959	541,000	2,541,000	
*1960	?	5,171,000	
1961	5,000,000	5,864,000	
1962	15,000,000	17,880,000	
1963	18,000,000	19,604,000	
1964	18,000,000	14,495,000	
1965	15,000,000	12,271,000	
1966	14,700,000	8,000,000	
1967	7,500,000	4,925,000	
1968	5,500,000	2,801,000	
1969	3,500,000	3,395,000	
Subtotal		$104,857,000	
		16,835,000	Emergency appr. before 1956
Total thru 1969		121,692,000	

*Emergency program ended in 1959, but Congress authorized a program of permanent bank stabilization the following year.

Annual Budget Requests and Appropriations for Separate Features of Arkansas River Navigation Project

2. Navigation Locks and Dams
Total Estimated Cost (1969) $475,000,000

	Budget Request	Appropriation
FY 1961	$381,000	$422,000
1962	1,225,000	866,000
1963	2,000,000	1,982,000
1964	11,000,000	9,680,000
1965	42,000,000	49,639,000
1966	79,000,000	73,500,000
1967	85,000,000	85,036,000
1968	100,400,000	77,470,000
1969	80,879,000	71,300,000
Total thru 1969		369,895,000

Annual Budget Requests and Appropriations for Separate Features of Arkansas River Navigation Project

3. Dardanelle Lock and Dam
   Total Estimated Cost (1968) $82,300,000

	Budget Request	Appropriation
FY 1956	---	$450,000
1957	---	524,000
1958	$800,000	910,000
1959	1,500,000	2,349,000
1960	5,000,000	3,719,000
1961	6,100,000	6,215,000
1962	9,000,000	7,877,000
1963	16,000,000	10,137,000
1964	20,000,000	21,342,000
1965	10,000,000	9,931,000
1966	1,700,000	1,949,000
1967	400,000	475,000
1968	3,500,000	3,825,000
1969	8,600,000	8,000,000
1970	4,346,000	4,346,000
Total (completed)		[1]$82,049,000

[1]Does not include preauthorization appropriations.

Annual Budget Requests and Appropriations for Separate
Features of Arkansas River Navigation Project

4. Ozark Lock and Dam
Total Estimated Cost (1969) $78,400,000

	Budget Request	Appropriation
FY 1962	$125,000	$298,000
1963	300,000	266,000
1964	285,000	312,000
1965	1,000,000	1,150,000
1966	9,000,000	9,926,000
1967	11,700,000	11,710,000
1968	12,000,000	11,569,000
1969	10,500,000	10,285,000
Total thru 1969		$45,516,000

5. Robert S. Kerr Lock and Dam
Total Estimated Cost (1969) $92,000,000

	Budget Request	Appropriation
FY 1961	?	$94,000
1962	$250,000	406,000
1963	531,000	381,000
1964	1,500,000	2,645,000
1965	6,000,000	10,651,000
1966	18,100,000	18,100,000
1967	27,000,000	20,700,000
1968	13,000,000	12,671,000
1969	14,200,000	11,209,000
1970	8,800,000	9,157.000
1971	5,986,000	
Total thru 1970		$86,014,000

Annual Budget Requests and Appropriations for Separate Features of Arkansas River Navigation Project

6. Webbers Falls Lock and Dam
Total Estimated Cost (1968) $78,300,000

	Budget Request	Appropriation
FY 1962	?	$129,000
1963	$325,000	248,000
1964	370,000	496,000
1965	1,000,000	2,874,000
1966	8,s00,000	6,125,000
1967	19,300,000	10,600,000
1968	14,700,000	12,765,000
1969	15,500,000	12,800,000
Total thru 1969		$46,037,000

7. Eufaula Reservoir
Total Estimated Cost (1967) $121,435,000

	Budget Request	Appropriation
FY 1956	---	$450,000
1957	---	1,285,000
1958	$5,500,000	3,488,000
1959	7,500,000	5,850,000
1960	13,400,000	7,902,000
1961	20,700,000	20,261,000
1962	28,000,000	29,488,000
1963	31,300,000	29,767,000
1964	18,500,000	17,175,000
1965	3,000,000	3,000,000
Total (completed project)		[1]$118,666,000

[1]Does not include some minor pre-construction appropriations.

Annual Budget Requests and Appropriations for Separate Features of Arkansas River Navigation Project

8. Keystone Reservoir
Total Estimated Cost (1967) $123,540,000

	Budget Request	Appropriation
FY 1956	---	$150,000
1957	---	1,482,000
1958	$4,000,000	1,932,000
1959	8,500,000	6,990,000
1960	10,000,000	9,538,000
1961	17,500,000	20,089,000
1962	27,500,000	28,190,000
1963	21,000,000	20,219,000
1964	15,500,000	12,344,000
1965	6,000,000	6,300,000
1966	5,500,000	5,600,000
1967	5,000,000	5,000,000
1968	4,579,000	4,579,000
Total (completed project)		[1]$122,413,000

[1]Does not include some minor pre-construction appropriations.

Annual Budget Requests and Appropriations for Separate
Features of Arkansas River Navigation Project

9. Oologah Reservoir
Total Estimated Cost (1967) $43,550,000 (phases I and II)

		Budget Request	Appropriation
	FY 1955	?	$397,000
	1956	?	1,000,000
	1957	$3,000,000	3,269,000
	1958	6,800,000	5,830,000
	1959	10,000,000	8,100,000
	1960	12,500,000	11,045,000
	1961	3,700,000	3,700,000
	1962	1,759,000	1,759,000
	Subtotal (completed first phase)		$35,100,000
	1965	?	30,000
2nd phase	1966	?	30,000
2nd phase	1967	$550,000	525,000
2nd phase	1968	1,350,000	916,000
	1969	3,500,000	3,120,000
	Total - 1st and 2nd phase thru 1969		$39,721,000

Cost of components of Arkansas multiple purpose project (1969 estimate)

Little Rock Dist.	County	Total est. cost	Const. began
Entrance channel			
Lock and dam No. 1	Arkansas	$22,200,000	May, 1963
No. 2	Arkansas	37,800,000	May, 1963
No. 3	Lincoln + Jefferson	32,700,000	May, 1964
No. 4	Jefferson	39,200,000	May, 1964
No. 5	Jefferson	28,600,000	Nov., 1964
No. 6	Pulaski	58,100,000	Jan., 1965
No. 7	Pulaski	29,400,000	Nov., 1964
No. 8	Perry + Faulkner	27,200,000	July, 1965
No. 9	Conway	32,600,000	April, 1965
Dardanelle L + D	Pope and Yell	82,300,000	June, 1957
Ozark L + D	Franklin	78,400,000	Dec., 1964
No. 13	Crawford + Sebastian	47,400,000	Oct., 1965
Tulsa District			
Lock and dam No. 14	LeFlore + Sequoyah	$30,100,000	May, 1966
Robert S. Kerr L + D	LeFlore, Sequoyah + Haskell	92,000,000	April, 1964
Webbers Falls L + D	Muskogee + Wagoner	78,300,000	Jan., 1965
Lock and dam No. 17	Wagoner	30,600,000	July, 1966
No. 18	Wagoner + Rogers	41,300,000	Oct., 1966
Bank Stab. and Channel rectification		133,000,000	
Upstream Reservoirs (1967 est.)			
Eufaula		121,435,000	Dec., 1956
Keystone		123,540,000	Jan., 1957
Oologah		43,550,000	

Sources of estimates:

For everything but upstream reservoirs, the leavings before the Public Works Appropriations Subcommittee of the House Appropriations Committee on the FY 1971 budget.

Upstream reservoirs: Annual Report of Chief of Engineers, U.S. Army, for 1967.

APPENDIX D

A FIELD SURVEY OF ATTITUDES TOWARD THE ARDP

While our task did not include formal field research, we did make two week long tours of the river valley towns and countryside, one each in Arkansas and Oklahoma, to obtain a feeling for the reactions and expectations of the local population concerning the ARDP. The report to follow is not a formal attitude survey, done on the basis of a selected sample of the population. It is, essentially, a piece of journalism informed by social science perspectives. However, the repetition of certain key responses was sufficient to give us fair confidence in the representativeness.

General attitudes

The most important difference in attitudes between Oklahoma and Arkansas was the greater awareness and excitement over economic development possibilities among government officials and businessmen in Oklahoma. The responses of the "average citizen" (people not directly affected by the ARDP) did not seem to differ in the two states. The responses for the Oklahoma section of people with more direct involvement indicate that the highly concentrated nature of the impact area, and the dominance of that area by the business community of one city, Tulsa, has resulted in greater awareness and inducement to participate in development activities. In Arkansas, the picture is much more diffuse, despite the fact that the Little Rock area is a zone of concentration, like Tulsa. Nevertheless, the economic involvements of the river in Arkansas are so diffused, and cover such a large section of the state, that the possible effects of the ARDP may not be visualizable as crucial.

The "average citizen's" responses can be characterized as follows:

a) Vague--little concrete knowledge of the ARDP and what it comprises.

b) Where pro-con fellings were visible, no strong bias was noticeable either way. Negative perspectives, when present, centered around fears that development would destroy the old ways of the community. Positive attitudes were generally pro business, but sometimes took the form of vague approval of anything to further "progress".

c) A fairly common attitude, considered neither pro nor con, took the form of "well...it won't do us much good, but you can't stop progress, I guess". That is, a sense of possible deprivations or disbenefits, but also a feeling of inevitability.

d) Generalized differences in responses depending on the nature of contact of the ARDP on the respondent's interests. Thus: people with land potentially saleable were more interested in the program, but not necessarily more "pro". People with hopes that better jobs or wages or business opportunities might result, were generally "pro". People who complained about the intermittent character of their jobs often felt that the development resulting from the ARDP might cure this ill.

The more "involved" responses can be illustrated as follows:

Optimism and approval:

> I think Muskogee has better possibilities than Tulsa. Tulsa, after all, is on a one-way stream and will probably have low water part of the year. There's a lot of ballyhoo going on in Tulsa but I think industry is going to concentrate around Kerr Lake [adjacent to Muskogee] and anyway the Oklahoma side of the river has better possibilities than Arkansas. There is a kind of spirit of competition between the two states, though cooperation on the common cause nevertheless. The river development project has done much to relieve a feeling of frustration among business circles. People are beginning to see results. In 1960 you couldn't get people to join JC's, but now there are 50 or 60 members here.
>
> Editor of small-town newspaper in town near Muskogee, on river

> I have sold part of my farm for lots along here and used the money to start this gas station and store. There'll be a lot of use for that kind of thing when the summer people move in. I worked hard for this and I am counting on it. It's hard to be a farmer these days--one year you do well and the next year you go broke. The river used to flood my bottomland quite often.
>
> Farmer and small businessman in town in NE Oklahoma, near tributary reservoir development

I guess the river will bring more jobs into the area, but I don't know anything about it, really. Flood control is an important thing. You know, I just can't wait to see those steamboats come up the river!

Farm housewife, and owner of small ceramics shop, on river town south of Muskogee, Oklahoma

I don't know what other people think about the project, but I'm all for it because I earned a lot of money working on that dredge--best wages I ever got! But they're going to have to change their tune about unions around here!

Young laborer, town on river, Arkansas

"Mixed" feelings:

The development is having an effect on zoning, with a problem as to whether the state or the municipality will control it. The state [Oklahoma] wants regional planning and that won't necessarily do the little communities any good. Tulsa is big enough to swing things their way. Some of us are worried that the Federal Government will step in and take things into their hands. Most of the people around here are skeptical and don't pay much attention to the news. There has been little good reporting of developments by the local news and radio people. There is a lot of negativism by people around here.

Radio news reporter for Tulsa station

Our town has really suffered on account of the river development project. Employers are coming in to take advantage of the cheap labor and are afraid of the unions. Land prices are going sky high and a lot of speculation is going on. I suppose the river will affect the shipping of coal but I don't think the industry will expand much. Not one industry has come to this town because of the river. The industries that do come ought to be clean--we are leery of smokestacks and low pay jobs. But tourism will definitely increase around here.

Chamber of Commerce official in small satellite city near Tulsa

I have been pushing this project for 25 years, but I am not as optimistic as some people. It isn't going to change anything overnight and any changes that do come will take a lot of hard work.

Newspaper editor, Muskogee, Oklahoma

I don't know what to think about it. There is a lot of talk here about bringing in industry and building a dock, but this is just talk.

Owner of small drive-in restaurant, river town, southern Oklahoma

The outsiders have been coming in and buying up land and hanging on to it. Since they are rich they don't care about agriculture. There's been a lot of talk around here about doing something about this project [the ARDP] but nobody organized any opposition.

Real estate operator, small town north of river, Oklahoma

The river scheme has meant the sacrifice of all the good farm land in the county. But the Corps paid good for it, and they shouldn't complain. There is a lot of growth around here, but it isn't always due to the river. Highway 40 played a big part.

Newspaper owner, small town in southern Oklahoma, on river

It is difficult to put any money value on the effects of this project. Some bad things can result: people will build on the flood plains thinking they are free of floods, and then flood damage will be increased. I suppose the most important thing will be to study the long-term trends in transportation on the river. If the demands are high enough, it will work. The average person in Little Rock knows nothing and cares little about the Arkansas River project.

Government official, Little Rock

The town as a whole benefits from the new industries, of course, but some people get hurt, like businessmen who get pushed out by the chain stores. People on fixed incomes also get hurt by rising costs and taxes. But people are really not opposed to the project around here, they still hope for something I guess. So far, the river transportation has not lowered transportation costs around here--I have to pay what I always did for my merchandise.

Small department store owner in Arkansas town, on river

Community response to possibilities*

There was probably general agreement that the river will cause changes, but a feeling that these changes will come slowly and will take local action. Many respondents in "elite" positions felt that their communities were not doing enough to promote possibilities, and some of these critics shared the caution of their compatriots. Underlying many responses was a feeling that things had never really improved, despite a lot of ballyhoo in the past--that Arkansas and Oklahoma were just not likely places for prosperity. Coupled with this was a genuine conservatism and a desire to leave things the way they are--especially on the part of small businessmen in the smaller communities:

> We are taught that if a town grows by more than 3% a year you have problems with services. The tax laws are antique and the whole setup is horse and buggy, so I don't see how you would get the money to do things. Here in Arkansas a company can move in and not have their property assessed for a year and even in some cases 3 years can go by before they pay taxes. We are always behind in school taxes, and street, sewers and water services. We'll have to make do if we get more industry. And it looks that we will.
>
> School superintendent, small town on river, Arkansas

> This is a good example of a "hill town", you know. People are slow to accept new things. A considerable group feels that the old ways are better and it's hard to organize people to get things done.
>
> Lawyer, small town on river, Arkansas

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*Also to be considered here is the attitude of the city and town populations toward bond issues designed to handle increased needs for services. Except in the large cities of Tulsa and Little Rock, the fate of proposals has been bad. Ft. Smith, for example, in 1969 proposed a major bond issue to develop the riverfront, which was defeated. A number of the respondents in the survey indicated that local people were content to let development remain in the hands of external or specially constituted bodies with their own funds.

> Both our towns are growing rapidly, and I guess part of it is due to the river transportation coming in. I kind of hate to see it grow, but that's progress, I guess.
>
> Owner of new marina in small river town, Arkansas

> There are lots of old-timers in Tulsa and Muskogee who don't want to see things change. They like things the way they are, and so do some of the professionals and educators who worry about urban growth. You don't hear these voices in the media and publicity, but they are there. Here you don't find much active promotion, they leave things up to the Port Authority, and wait and see.
>
> Newsman, Tulsa

While many of the respondents who described these attitudes were somewhat critical of them, there was also a feeling that caution may be wise, and that growth is not always what it is supposed to be--not an unmixed blessing. A few respondents mentioned undesirable ecological consequences: pollution, downdraw, crowding, noise. The more critical comments on local elitist conservatism came either from booster type businessmen, or from working people, both of whom felt they had much to gain from the river project.

All of the respondents associated with news media noted that the information supplied them on the river project was one-sided and not very convincing. They did not necessarily tie this to criticism of the project, only felt that in order to "sell" the project to the public they ought to have something better than promotional handouts from Chambers of Commerce, state development agencies, and the Corps.

There was little direct criticism of the Corps, and little awareness of any important role the Corps might have played in promoting the project. Negative comments on government usually took the form of a generalized fear that big government does what it wants, and nobody can stop it, therefore one might as well ride along. The Corps was sometimes included in such generalized attitudes:

> The Corps did a good job around here
> but of course they're a big outfit
> and they do what they think best.
>
> Store properietor, river town, Okla.

<u>Who benefits? Who loses?</u>

Respondents were aware that the port cities would benefit the most, and perhaps also the outlying regions including recreational reservoir developments. That is, other than districts receiving visible impact, there was a wait and see attitude, associated with the generalized conservatism mentioned previously.

Respondents also recognized that businessmen, especially those associated with industry, would be likely to benefit, but that small businessmen might be hurt.

Farmers were mixed in their opinions. Most regretted the loss of good farmland, but many, especially in dry Oklahoma, were ready to get out of the risky business and were happy to sell their land. In Arkansas the picture was different; the profitability of agriculture in this humid state was felt to be a real loss. One respondent in the Delta region felt that to substitute recreation for agricilture was a mistake, because the area was too humid and buggy for tourists and summer people, "though people can put up with it if they want to".

The prevalence of outside contractors for river works construction, and for construction of new factories, was singled out by several respondents for criticism.

A remark that summarizes the general attitudes toward gain and loss:

> Some things win and some lose--some communities will grow and others will die--that's what happens in projects like this.
>
> Small businessman, Oklahoma

In conclusion: the response to the ARDP varies by involvement. Farmers who lose bottomland may resent it; people who want to sell land may welcome it; businessmen who stand to gain, approve; those who may lose, are anxious if not outright opposed. Laborers who get high wages are for it; union labor is mixed. Local officials and media people mix booster optimism with caution and skepticism. Some communities have moved to attract new business; some have hung back. Those who have done the former are usually in an area of direct impact: port towns, near tributary reservoirs, in satellite centers to large cities.

The "average citizen", not involved with the project directly, not standing to gain immediately, was indifferent. These people were not quoted; their remarks were largely dismissals of the topic: "Don't ask me, I don't know anything about it." A few felt that since most of the work on the project, and most of the new industries, were affairs of outsiders, not even Oklahomans or Arkansans, the whole thing is something done by God and its effects locally were something to wait and see.

The attitudes therefore hang in the balance: failure of gains to materialize, or the accumulation of felt disbenefits, could easily move feelings in strong negative directions. But positive feelings are general, though not strong, and there is something of a reservoir of good feeling about the whole project and its results.

APPENDIX E

A METHOD FOR STUDYING THE IMPACT ON PROJECT COSTS OF CE LAND ACQUISITION POLICIES

The appropriate price for project site land is imprecisely established by the vague equity concepts, "just and reasonable consideration" and "fair market value" contained in section 301 of the Land Acquisition Policy Act of 1960 (33 USC 596; 74 Stat. 480) which delineates current public policy on land acquisition by federal agencies. Over time, congressional redefinitions of land acquisition equity criteria have tended to strengthen the bargaining position of the landowner, and have probably, thereby, raised the cost of land acquisition for the CE and other federal agencies. The Land Acquisition Policy Act of 1960 seems itself to have been an important step in this direction. (See CE Circular 405-1-28 Real Estate Acquisition: Analysis of Sec. 301, P.L. 86645). That Congressional pressures for greater generosity to private owners are continuing, is evidenced by two bills, S. 3815 introduced in the Senate by Senator Tower of Texas, on May 6, 1970, and H.R. 17505 introduced in the House on the same day by Congressman Wright, also of Texas. These identically worded bills would ammend Section 301 of the 1960 Act so that

> the just and reasonable consideration to be paid for property taken by the United States above the normal high water mark of navigable waters in the United States shall be the fair market value of such property, including the value of any riparian use which may exist at the time of taking of such property or for which such property would be suited with reasonable probability in the foreseeable future, and disregarding the exercise of any navigational servitude of the United States involved in the taking itself or any potential exercise of such servitude. In order to facilitate the acquisition of land and interests therein by negotiation with property owners, to avoid litigation and to relieve congestion in the courts, the Secretary of the Army (or such other officers of the Department of the Army as he may designate) is authorized in any negotiations for the purchase of such property to pay a purchase price which will take into consideration the policy set forth in this section.

Thus should these bills become law, the CE might be required, under one possible interpretation of the clauses underlined, to pay a price for shoreline land that also incorporates the future riparian benefits accruing to that land from the construction of the CE project.

Since increases in land acquisition costs raise the total cost of CE projects, greater generosity to landowners could result in a reduction of the number of projects authorized, in delays in their execution because of budgetary constraints, or in higher appropriations from the federal budget for such projects. Were the first two effects to predominate, the major impact of higher land acquisition costs would be born by the non-landowning citizens of the regions with projects aborted or delayed because of higher costs. Were higher federal appropriations to be the main consequence, the loss of social benefits provided by these projects would be minimized, but the already sizeable income transfers from rich to poor states that has resulted from the particular geographic concentration of CE projects[1] would be accentuated. It would be accentuated, however, in a manner which can not easily be justified on egalitarian grounds, since the distribution of landownership in the impacted regions tends to be highly skewed.

The trend in congressional legislation toward more generous compensation of landowners can be explained by either of two competing hypotheses. One view is that the trend reflects congressional response to a desire on the part of the general public to give the sellers of project-acquired land a larger share of the future benefits from the projects. The alternative hypothesis is that the congressional trend merely reflects a piecemeal response to particularist pressures from project areas made possible by inadequate awareness on the part of the rest of the public of the social costs and distributional consequences of the trend.

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[1](cf. Robert H. Haveman, Water Resource Investment and the Public Interest, Chapter 4).

One useful way of determining which hypothesis is more valid would be to see whether the growing generosity of Congressional legislation has been matched by a similar tendency in land acquisition policy for state financed projects. Similar trends would strengthen the hypothesis of a genuine change in public equity norms. Evidence that prices of land acquired for federally financed projects has been persistantly higher than the prices paid for similar quality land acquired for state financed projects, would, on the other hand, tend to refute that hypothesis and strengthen the plausibility of the alternative one.

Due to the size and the lengthy construction period of the Arkansas River project, the CE has acquired a wide variety of types of lands in Arkansas and Oklahoma over a time span that bridges the passage of the 1960 Land Acquisition Policy Act. The real estate sections of the CE District Offices in Little Rock and Tulsa do have on file a range of data for carrying out the above test as well as for studying other important facets of the land acquisition equity issue. Specifically, we suggest the following three projects.

<u>A study of the impact of the 1960 Act on the ratio of prices paid to appraised value of the acquired parcels.</u>

All the requisite data for this study already exists in the files of the two district offices, so that the main effort would be computational. Multiplying the percentage rise of the average ratio after the 1960 Acquisition Act policy was put into effect by the appraised value of land acquired under that policy would yield an approximate estimate of the increased dollar cost to the Arkansas River project of the change in acquisition policy.

<u>A comparison of CE land acquisition prices with those of state agencies for comparable parcels.</u>

As best we can determine, such a comparison can readily be done for Arkansas, where the Game and Fish Commission, which seems to have done extensive purchasing of land through most of the period in which the Arkansas River project land was being acquired by the CE, would be an appropriate agency for making the comparison. In Oklahoma, however, the comparable agencies, the Wildlife Commission and the Industrial Development and Parks Department, bought very little land during the relevant time span. This particular study would thus probably have to be limited to Arkansas.

The comparison is likely to turn up systematically lower acquisition prices for Game and Fish Commission purchases. This, at least, is the opinion of Mr. Thrusten Holden, for many years in charge of land acquisition for the Game and Fish Commission and now a consultant to the Arkansas Planning Commission. Holden's explanation of the presumed difference is that the Game and Fish Commission of Arkansas has greater flexibility in its land acquisition procedures, than does the CE. Some of the flexibility stems simply from the different uses to which the land is to be put. Most of the CE land needs is precisely delineated by the engineering plans of the water project, whereas the Game and Fish Commission, which purchases land primarily for recreation and conservation, can adjust the location and amount of acreage purchased when the asking prices seem too high. These differences in flexibility are compounded, however, by differences in land acquisition procedures governing the two agencies. In the case of the CE, engineering plans and project land requirements are announced well in advance of the specific congressional appropriations for purchasing the requisite land, thereby enhancing the opportunities for private land speculation. Under present congressional guidelines, the CE cannot protect against this by taking options on the requisite land at the time the project is announced. Its main defense is condemnation under eminent domain. Condemnation procedures, however, are costly, time consuming, politically abrasive and rather ineffective in thwarting speculative price increases. The state legislation governing the Arkansas Game and Fish Commission, on the other hand, evidently allows the Commission to be more opportunistic in the timing of its land purchases, thereby increasing the risk and reducing the expected return for land speculators.

Holden's opinion is plausible but it would be useful to measure the extent of the land acquisition differentials, if any, resulting from the differences in flexibility of the respective acquisitions policies. The following are two suggested methods of comparisons that could be attempted. In each case Holden would be a valuable and willing consultant on the use of the Game and Fish Commission land data for the comparisons.

One easy but not very precise method of comparison would be simply to compare the annual or biannual sales price to assessed value ratio of the CE with that of the Game and Fish Commission, beginning with the year the CE began to make major land purchases for the project, or perhaps a few years earlier.

With greater effort, a more interesting disaggregated comparison would be possible. The procedure would be to match CE parcels with those acquired by the Game and Fish Commission along four dimensions: a) geographic district; b) land type; c) year of purchase; d) purchase price per acre. Data on all these dimensions should be obtainable from the land appraisals and sales agreements in the files of the CE and the Game and Fish Commission. In comparing parcels, the terms of the sale should be checked closely. As we understand it, the CE purchases are generally in fee simple, while the Game and Fish Commission will often allow the former owner to retain timber and mineral rights for a period of years. Ideally, it would be best to limit the comparisons to fee simple transactions. If, however, this reduces the number of comparable pracels drastically, it may be necessary to expand the number by including other types of sales, adding the appraised value of the timber and mineral rights to the Game and Fish purchase price to arrive at an estimated fee simple price.

Test for differential rates of turnover between Corps and non-Corps land.

According to some observers, a sizeable portion of the land acquired for the Arkansas River project had previously been purchased by local and out of state owners in anticipation of profitably reselling the land to the CE. If true, and given that land in rural Arkansas and eastern Oklahoma normally turns over very slowly, anticipatory purchases of CE land should show themselves in a higher rate of turnover in the period preceding CE acquisition.

This can be tested by two complementary calculations. In the first, the parcels purchased by District Offices for the Arkansas River project are traced back in the county recorder of deeds office to ascertain the number of times the acreage was sold in the ten years preceding CE acquisition. To reduce cost and time, all transactions of less than 10 acres can probably be excluded on grounds that speculative purchase is likely to relate to larger parcels. A turnover index is then constructed for each quinquennium of the ten year period using the formula $T = \frac{\Sigma(ta)5}{A}$, where A is the total acreage purchased by the CE for which full 10 year sales and ownership records can be obtained, and a is the number of such acres sold t times, $t = 0, \ldots \infty$) in each five year period. A pickup in speculative purchases should show itself as a higher value for T in the more recent period.

Since a rise or fall of T between the first and second five year periods could also reflect a general underlying pattern for the region, it will also be necessary to calculate T for a sample of non-CE land areas.

In the case of Arkansas, the matching Game and Fish parcels indicated above could be used as the sample. In Oklahoma the matching sample might be all the remaining rural land of the counties in which the CE acquired land, identified from aerial photos as noncontiguous to the CE land and sufficiently inland from the river as to minimize the likelihood that the land might benefit from the completed project as a port or industrial site.

The second calculation would use the data obtained for the above research to ascertain whether absentee ownership was abnormally prominent for CE acquired land. In Arkansas, this would merely involve getting the addresses of the sellers of acquired parcels from the CE and the Game and Fish Commission files, respectively. The total acreage purchased by each agency could then be subdivided into

1. acreage sold by owners with addresses in the same county as the land purchased.
2. land sold by owners with addresses in a different county than the land purchased, but in the same state.
3. acreage sold by owners with out of state addresses.
4. acreage for which the true owner's address is unclear.

In Oklahoma, the ownership distribution of CE acquired land could be compared with the ownership distribution of the rural land of the previously indicated matching sample.

APPENDIX F

THE RESEARCH BASE FOR DETERMINING THE POLITICAL EFFECTS OF THE ARDP

As in the case of both economic and sociological effects we have the twin problems of "observing total change in the region" and "factoring out the share of change due to the Arkansas River Development Project" in regard to political effects. In regard to both questions, moreover, the problems of establishing a reliable methodology are even more serious than in the case of sociological impacts. A change in a region's politics and political organization certainly can be described, and information to do so abounds. On the other hand, summarizing such information into a clear picture of a change in the total political picture is not really possible. Political effects are inherently multi-dimensional and the significant dimensions are very difficult to specify in advance.

In the case of "factoring out" the effects of river improvement we face the problem that political change ordinarily is thought of as a change from one state to another (and then to another, etc.) by rather discontinuous jumps, and not something that changes in a continuous and more or less linear way with economic and social variables.

Therefore, while it would be naive to think of research that would determine the <u>quantity</u> of political change and the <u>fraction</u> due to the navigation project, it is possible to think of an analysis of political consequences, broadly defined, and to think of a qualitative analysis of the role of the ARDP in the propagation of such change. It is also the case that political change from the project is not likely to be substantial, and would probably have a bigger impact on the kinds of people holding public office and the kinds of programs they would support, than on the political structure itself. In any event, in this section we attempt to suggest some of the more likely political consequences that may occur in Arkansas and Oklahoma as a result of the development of the Arkansas River, and how such speculations may be verified.

It is necessarily a tentative enterprise since little in the way of substance or even speculation exists in the literature on this type of problem. Therefore, some conceptual and methodological points in the context of the political complexion of the region will be discussed first, before considering some more specific possible political impacts.

There are hazards in projecting any type of consequence of regional development. In the case of river basin development, such as that being completed on the Arkansas, some consequences are less difficult to predict than others. There is at least a sufficient body of economic theory and practice on the subject to facilitate the making of projections into the future. There have been few, if any, notable attempts at describing or discussing the political consequences of river basin development. The literature dealing with politics and water resources concentrates largely on the managerial and administrative arrangements used to deal with problems of water resources development, and to some extent, the political issues surrounding basin development.[1] Basically,

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[1]Some examples of literature on management or planning aspects are: Dean Mann, The Politics of Water in Arizona, Univ. of Ariz. Press, 1963; Roscoe C. Martin, Water for New York, Syracuse Univ. Press, 1960; Robert H. Pealy, Organization for Comprehensive River Basin Planning, Univ. of Michigan, 1964; Roscoe Martin et. al., River Basin Administration and the Delaware, Syracuse Univ. Press, 1960.

Among the literature on political aspects of basin development are Philip Selznick, TVA and the Grass Roots, Univ. of Calif. Press, 1949; Arthur Maass, Muddy Waters, Harvard Univ. Press, 1951; Charles McKinley, Uncle Sam in the Pacific Northwest, Univ. of Calif. Press, 1952; Norman Wengert, Natural Resources and the Political Struggle, Doubleday and Co., 1955; Marion Ridgway, The Missouri Basin's Pick-Sloan Plan.

such attention as has been focused on the political aspects of water resource developmenthas been concentrated either on the input phase of project authorization or the ongoing processes of administration and management. Little or no attention has been paid to what happens in either the short or long-term by way of adjustment of the region to the project. As indicated above, there are a number of conceptual and methodological problems that should be discussed before one would undertake the task of estimating political consequences of the Arkansas River project.

Of great importance is the fact that if one is going to attempt to measure political changes over time, the problem of time lag becomes very important. This is, of course, a problem in measuring impact of any variety. But certain types of consequences, such as industrial development and population increase are expected to occur soon after and perhaps even before completion of the project. On the other hand, whatever political consequences follow as a result of the Arkansas project are not likely to be perceptible in the short run. They are more likely to be of a long-term and unanticipated nature. There are at least two good reasons why one would expect this to be the case. The first is the obvious one that political change is not a contemplated goal of the project. The justification and the goal of the project is primarily the economic development of the region. In addition, however, it is unlikely that the political elites in the region, who are likely to be "locals" in orientation (as opposed to "cosmopolitan") would support any kind of project which they believedmight have direct, identifiable and immediate impacts on the political _status quo_ in the region.[1] Such impacts might be a threat to

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[1]Peter Rossi defines these two terms, originally used by Robert K. Merton, as follows: "'Locals' are those who have achieved positions of leadership

their dominant position in the political leadership structure. So due to the probable long-run nature of political impacts, available relevant political data may not show any demonstrable changes for some time.

Related to the problem of the time lag is that of multiple influences. Assuming that the data collected show some perceptible changes over time, the problem then becomes one of determining the source or course of the change. Political change may occur at a given time in response to any number of factors and influences. It can also occur over time in response to both short-term and long-term influences. The purpose of this effort, of course, is to supply at least some speculation or conceptualization as to the most likely areas of political change resulting from the Arkansas project, and suggesting possible sources of influence in these changes. But this does not mean that projected changes which materialize can automatically be attributed to the project alone--or, at all. Probably the best that can be achieved is first to hypothesize some consequences, and if a change in a suggested indicator of that consequence is perceived, attempt to sift out the potential causes, and then an informed judgment as to their relative weights.[1]

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within regions or communities on the basis of their being embedded in the interpersonal networks of their localities. 'Cosmopolitans', in contrast, are those whose position in the locality is based on their position as holders of special skills or holding down positions in organizations which are supra-local in character. Thus, school superintendents, managers of industrial corporations, city managers, and hospital administrators are often 'cosmopolitans', and merchants and politicians are more likely to be 'locals'." Peter Rossi, "Social Change and Social Structure in the American Local Community," in Ronald R. Boyce, ed., Regional Development and the Wabash Basin, Univ. of Ill. Press, 1964, p. 115.

[1]An illustration of the difficulty involved in ascertaining the sources of political change might be taken from electoral politics in Arkansas and Oklahoma for state and national office. In the past few years there has been an increased degree of success by the Republican Party in the previously

Three aspects of Arkansas and Oklahoma that seem to be of political significance in relation to the development of the Arkansas River (there may be others) are the regional setting of the states, their respective political cultures, and the activism of their governments as expressed in terms of expenditures for governmental services.

In a recent book,[1] a political scientist distinguishes between four types of designations of "region" found in the literature on regionalism. "In one sense, the region is a natural area that is made distinct by geographical, climatic, or agricultural features..."[2] A river valley is an example of such a region. By this criterion, Arkansas and Oklahoma may be looked upon by some as a distinct region. But people familiar with the area know that there are significant differences between and within the states. The two states are usually placed in different regions. In four separate groupings of the 48 contiguous states, Sharkansky separates them three out of four times. Arkansas is traditionally considered part of the Old South or Confederacy. Oklahoma is usually considered to be part of the West or Southwest. Their seventy year difference in statehood may be a partial reason for Arkansas and Oklahoma rarely being thought of as a unit.

Democratic strongholds of Arkansas and Oklahoma. The Republicans have made inroads in the House delegations as well as the state houses, and one Republican has been sent to the U.S. Senate. One of Arkansas' four representatives is Republican, as are two of Oklahoma's six Congressmen (although only one of Oklahoma's can be attributed to any recent political change). In 1966 Arkansas elected and in 1968 reelected its first Republican Governor in almost 100 years, and Oklahoma, which had never in its history elected a Republican Governor until 1962 has elected two in a row since then. Can these changes be attributed in some way to increasing economic development in these states resulting in changes in party affiliation? Or perhaps it is a short-term factor such as the attractiveness of the individual candidates or a particularly heated issue. If similar changes are occurring in other traditionally Democratic strongholds in the South--or indeed, throughout the country--then the likelihood is that change is due to more widespread influences occurring over a longer period of time.

[1]Ira Sharkansky, Regionalism in American Politics, Bobbs-Merrill Company, 1970.

[2]Ibid., p. 163.

Contributing to their distinction in regional terms are the differences in the political cultures of Arkansas and Oklahoma. Sidney Verba has defined political culture as "the system of beliefs about patterns of political interaction and political institutions. It refers not to what is happening in the world of politics but what people believe about those happenings."[1] According to two other authors, "Political culture, conceptualized roughly, is the pattern of distribution of orientations members of a political community have toward politics."[2]

In his book American Federalism: A View from the States,[3] Daniel Elazar distinguishes three varieties of political culture in the United States--moralist, individualist, and traditionalist. He sees political culture as the particular pattern of orientation to political action in which each political system is embedded. The individualist and traditionalist subcultures are the ones relevant for Arkansas and Oklahoma.[4] Elazar differentiates the

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[1]Sidney Verba, "Comparative Political Culture," in Lucian Pye and Sidney Verba, Political Culture and Political Development, Princeton Univ. Press, 1965, p. 516.

[2]Richard Dawson and Kenneth Prewitt, Political Socialization, Little, Brown and Co., 1969, p. 27.

[3]Daniel Elazar, American Federalism: A View from the States, Thomas Crowell Co., 1966.

[4]According to Elazar, the individualistic political culture emphasizes the democratic order as a marketplace. "Since the individualistic political culture emphasizes the centrality of private concerns, it places a premium on limiting community intervention--whether governmental or nongovernmental--into private activities to the minimum necessary to keep the marketplace in proper working order...The individualistic political culture holds politics to be just another means by which individuals may improve themselves socially and economically. In this sense politics is a 'business' like any other that competes for talent and offers rewards to those who take it up as a career. Those individuals who choose political careers may rise by providing the governmental services demanded of them and, in return, may expect to be adequately compensated for their efforts." (pp.86-7)

"The traditionalistic political culture is rooted in an ambivalent attitude toward the marketplace coupled with a paternalistic and elitist conception two states along cultural lines, Arkansas fitting squarely into his "traditionalist" subculture with the rest of the Old South, and Oklahoma having a mixed variety. In its eastern reaches, Oklahoma shares the traditionalist subculture, but the remainder of the state tends more and more toward the individualist subculture. The midsection of Oklahoma is a mixture of the two subcultures. Elazar has pointed out elsewhere: "While sectional boundaries are determined by state lines, which are normally the most significant in the identification of political variables, there are also regional influences that cut across state boundaries."[1] Thus there are differences between Arkansas and Oklahoma, but also within Oklahoma itself.

Sharkansky draws some distinctions between regions that add some substance to these differences in political culture. Sharkansky describes several characteristics of the Southeast (which includes Arkansas but not Oklahoma). Southeast states score lower than the national average in many aspects of policy in the fields of education, highways and public welfare. But in expenditures of state governments for education and welfare, and in state government tax effort, the Southeast scores above the North. This reflects the relative "centralization" of Southern state governments. In addition, state legislatures in the Southeast are larger and more active than those

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of the commonwealth. It reflects an older, pre-commercial attitude that accepts a substantially hierarchical society as part of the ordered nature of things, authorizing and expecting those at the top of the social structure to take a special and dominant role in government. Like its moralistic counterpart, the traditionalistic political culture accepts government as an actor with a positive role in the community, but it tries to limit that role to securing the continued maintenance of the existing social order." (pp. 92-3)

[1]Daniel Elazar, "Influences on Political Values and the Wabash Basin," in Ronald Boyce, op. cit., p. 132.

west of the Mississippi. This, says Sharkansky, reflects the importance of state institutions in Southern government, while localities are assigned a relatively small role. He places Oklahoma in either the Border states region or the Southwest. Both of those regions show certain traits of the South, like low reliance on real property tax. The Border states score low in highway services, but the Southwest shows the western trait of high scores on highway services. In Southwestern legislatures, the two parties have little control over the voting of members, who tend to vote on the basis of nonparty cues.[1]

Another author has found evidence for a clear break between the two states. Glenn Fisher shows a sharp difference between the states in expenditures for certain governmental services,[2] an indicator that will be discussed as a measure for potential political impacts. Fisher compared actual state and local expenditures for governmental services with estimates of "expected" expenditures based on three independent variables--per capita income, population density and degree of urbanization. This comparison for any given state would suggest the extent to which factors other than the independent variables (e.g. cultural factors) have influenced expenditures in the states. Fisher obtains an overall index of -.74 for Arkansas and +.65 for Oklahoma, indicating Arkansas' expenditures were well <u>below</u> and Oklahoma's well <u>above</u> what one would expect on the basis of the variables employed. Fisher also showed coefficients for separate policy areas.

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[1]Sharkansky, op. cit., p. 142

[2]Glenn Fisher, "Determinants of State and Local Government Expenditures: A Preliminary Analysis," <u>National Tax Journal</u>, December, 1961.

	State Institutions of Higher Education	Local Schools	Highways	Public Welfare	Health & Hospitals	General Control
Arkansas	- .3	-1.1	-.7	+ .1	-.1	+.1
Oklahoma	+1.1	+ .2	+.3	+3.2	-.9	-.2

One possible implication of these figures is that there is something in the cultural heritage of the two states which accounts in large part for the variations in state expenditures. In fact, certain aspects of political culture that Elazar says are influential in shaping the operations of state political systems might in part explain these variations. The first aspect is especially pertinent. It is the set of perceptions of what politics is and what can be expected from government. If the people and the political elites agree that government should intervene as little as possible in the private sphere, this could account largely for lower than "expected" expenditures. The traditionalist political culture which Arkansas shares with the rest of the South is "instinctively antibureaucratic," according to Elazar, which might explain a low score on governmental services. Since Oklahoma's statehood dates from a period of governmental "progressionism," there may not be as great a bias against government as there is in Arkansas. In addition, Oklahoma shares the individualist political subculture which looks upon politics as a "business", which is much more likely to render services in exchange for votes and is more ambivalent about bureaucratic aggrandizement.

A second aspect of political culture cited by Elazar is the kind of people who become involved in government and politics as holders of elective office, members of bureaucracy and active political workers. Changes in the recruitment patterns of political and administrative personnel might signal changes in the political power structure and perhaps modifications of the political culture. Such changes will be discussed later as potential impacts of river development.

A third aspect of political culture is the actual way in which the art of government is practiced by citizens, politicians and public officials. We refer to this aspect of the culture as the "style" of political life. Although it is an even more difficult kind of factor to measure than recruitment and much more difficult than expenditures, it is quite possible that the political style within a region would be affected as a result of regional development.

Some political impacts and indicators

The states of Oklahoma and Arkansas have both suffered net losses in population over the last several decades, at least through 1960. From 1930 to 1960, Oklahoma's population declined by 68,000. The situation in Arkansas is exactly similar--a net loss in population of 68,000 in the period.

A major reason for population decline, of course, was the relatively underdeveloped nature of the economy of the region and the consequent lack of economic opportunity. One of the goals of the Arkansas River project was to develop the two-state region economically and hopefully enable it to hold its population as well as draw migrants from other regions. This has apparently already occurred to some extent. If in the future the Arkansas River region begins to attract significant numbers of people from other areas, a set of political consequences may occur as a result of this influx. This set of consequences is due in large part to the kinds of people likely to be attracted to the region by economic opportunity.

It is likely that the political and governmental structures in Arkansas and Oklahoma are fairly firmly in the control of "locals"--people whose influence and power stem from their long ties with the area and the population. The people attracted to the region will be "cosmopolitans" in orientation.[1] The control of party by the locals is partly due to the dominant American political party sturcture, where party control is concentrated at the local level. People without strong local ties are at a particular disadvantage in gaining political office. Dominance by locals may be true not only to elected officials, but also of administrative personnel in various governmental or quasi-governmental units such as school boards or other special districts.

The in-migrants will be cosmopolitans, at least relative to the locals, by their detachment from local affinities and by virtue of their contact with a wider community and their wider experience. Also, as indicated by the fact that they are attracted to a new area by economic growth, they probably will be "growth-oriented" and will favor programs contributing to such growth. In this respect they will probably differ from locals. Elazar points out that cosmopolitans and locals react differently to proposals for innovation and change. By and large, he argues, locals tend to support the initiation and maintenance of social welfare programs, which appear to bring them direct benefits for the least cost, and to oppose community development programs whose benefits are considerably less apparent.[2] This generalization, of course,

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[1]See footnote 1, page F-3.

[2]Elazar in Boyce, op. cit., p. 138.

at least regarding the social welfare programs, may not hold true in a traditionalist subculture such as Arkansas', where one would expect a bias against social welfare programs. In Oklahoma it probably applies more accurately. In general, we can probably expect cosmopolitans to have higher expectations about the quality of governmental performance and the proper level of government services. This would probably apply to social welfare programs as well as to development programs. Even if the in-migrants are largely from the South, which is difficult to predict, their growth-orientation will provide motivation to seek higher levels of government services, particularly in the field of education.

We have already indicated that Arkansas lags and Oklahoma surpasses the "expected" expenditures in various spending categories. In order to measure possible changes in government services resulting from the "cosmopolitanization" of the region, it would be useful to accumulate data over time on a number of categories of government spending. In other to relate it to river development we would want expenditures broken down by county. The annual compendium of state and municipal finances published by the U.S. Department of Commerce does not give such a breakdown, but the Census of Governments, which is published every five years, does. Considerable data are available from 1962 and 1967 Censuses of Governments for the two states on per capita expenditures for several government services by county. If these data were accumulated over time, as well as some data on municipal finances, they may begin to show some significant differences between river and non-river counties.

A second area where "cosmopolitanization" might lay the groundwork for political change is in the area of political recruitment. The population attracted to the region will provide larger and more diverse pool of individuals from which government personnel for such bodies as school boards, libraries, zoning commissions, etc., may be chosen. Some of these bodies will be elective, others appointive. Boards of directors of school districts are elected in both Arkansas and Oklahoma, as are the governing bodies of other special districts, such as levee districts. Other special districts have governing bodies made up of appointed officials. In addition to changes in administrative personnel, there may be impacts on the pattern of recruitment to legislative or other elective office. It is difficult to say whether elective or appointive positions would be easier for cosmopolitans to attain. Some data showing the number or percentage of cosmopolitans filling elective vs. appointive positions may be helpful for future efforts such as this one.

In order to discern changes in patterns of recruitment to governing boards, data is needed on what types of people serve on these bodies. Biographical information would be particularly useful for this. Besides learning about changes in the type of personnel, however, it would also be interesting to learn if the interaction between newcomers to these governmental bodies and those older groups who continue to serve on them has any noticeable impact on the expectations of the older groups. Contact by the older groups with newcomers may influence or transform the role expectations, for example, of the older group. Perhaps there will be a change in the role orientation from the impartial "administrator" to the partial "advocate" or vice versa.

Raw data on the number of personnel in various governmental positions is supplied in the Census of Governments. This gives no information of a biographical nature, however. It does include data on payrolls for various governmental units, trends in which could be used as rough indicators of changing value patterns regarding certain governmental services, or perhaps of the quality of persons recruited to these positions. But biographical information is really the necessity here. In lieu of a document containing such information, perhaps the best approach is to obtain the information directly from government bodies by asking them for data on the backgrounds of their personnel. As far as the transformation of role expectations of older members is concerned, this would necessitate the obtaining of some interview or questionnaire data over time. The views of the more senior members about several things should probably be obtained: views on the proper role of government, about their own task, on the need for innovation and change, on the proper posture regarding "administrative" vs. "political" activity, on the function of the body or agency in question, etc. Changes in attitudes toward these issues might signal "cosmopolitanization" of locals by interaction with the newcomers.

The influx of cosmopolitans may also affect the more traditionally "political" types of offices, such as state legislators or local officials, such as county judge. It may have impacts on the recruitment patterns of these elected officials as well as on tenure and turnover in these state and local offices. If "locals" are indeed entrenched in political office at the local government level, then there is some likelihood that in state legislatures, for example, tenure will be long and turnover relatively low. Tenure in the two houses of the Arkansas legislature seems to be somewhat mixed. One indicator used to measure tenure (and turnover) is the percentage of new members in the respective houses. Data on this measure for Arkansas is presented below:

Percent of New Members in House, Senate and Total Assembly

	% Senators	% Representatives	% Total
1957	20.0	36.0	31.9
1959	20.6	35.2	31.3
1961	22.9	31.0	28.9
1963	37.2	29.0	31.2
1965	40.0	18.0	23.8

Source: Donald T. Wells, "The Arkansas Legislature," in Alex B. Lacy (ed.), Power in American State Legislatures. Tulane Univ. Press, New Orleans, 1967, p. 13.

It appears that two opposing trends are operating here in the two houses. Overall, however, there is a general decrease in new membership in the Assembly and therefore an increase in tenure. For the Oklahoma legislature, the converse of the measure used for the Arkansas legislature was employed. Turnover was measured by the percentage of incumbents in the two houses.

Percent Incumbents in Oklahoma Legislature

	Avg. 1945-63	1965	1967
House	57.7	54.0	78.7
Senate	77.3	46.0	87.5

Source: John W. Wood, "The Oklahoma Legislature," in Lacy, Power in American State Legislatures, p. 147.

The experience of legislators was also measured by the average number of sessions per legislator from 1945 to 1967.

Average Sessions/Legislator in Oklahoma Legislature

	Avg. 1945-63	1965	1967
House	1.5	2.0	2.2
Senate	2.5	2.2	2.5
Senate (incl. House Exp.)	3.6	3.2	3.5

Source: John W. Wood, "The Oklahoma Legislature," in Lacy, Power in American State Legislatures, p. 147.

Due to the use of an average for 1945-63, it is difficult to spot any kind of trend. But tenure does seem to be increasing for legislators in Oklahoma as well as Arkansas.

It seems quite possible that, despite the relatively short-term nature of this increased tenure in the two states, the availability of cosmopolitans for legislative office will contribute to a shortening of tenure. It may also have an impact on the kinds of people elected. Data on the social background of legislators over time would be helpful in discerning changes in recruitment. Occupation is only one aspect of social background, but it is significant. Below are distributions of Arkansas and Oklahoma legislators by occupational categories.

Occupations of Arkansas Legislators, 1957-65

Occ. Group	Representative		Senator		Total	
	#	%	#	%	#	%
Farmer	74	14.9	15	8.6	89	13.3
Lawyer	109	22.0	64	36.7	173	25.9
Businessman	245	49.5	79	45.4	324	48.5
Teacher	31	6.2	14	8.0	45	6.7
Professional	17	3.4	1	.5	18	2.7
Misc.	18	3.6	1	.5	19	2.8

Source: Donald T. Wells, op. cit., p. 11.

Occupations of Oklahoma Legislators, 1945-67

Occ. Group	1945-63		1965		1967	
	House	Senate	House	Senate	House	Senate
Business	39.9%	27.5%	54.4%	37.0%	41.4%	35.4%
Lawyer	30.9	40.4	22.0	42.0	22.2	43.8
Farmer	21.7	28.4	21.0	6.0	21.2	6.2
Education	9.7	13.1	4.0	4.0	5.1	2.1
Other	5.9	3.9	4.0	12.0	10.1	12.5

Source: John W. Wood, op. cit., p. 145.

In the recent past, businessmen have predominated in the Arkansas legislature, while both lawyers and businessmen are frequently elected in Oklahoma.

Other characteristics of legislators helpful in measuring changes in recruitment and which should be relatively easy to obtain are place of birth, length of residence in the area and level of education. This information will tell us something about the ties of legislators to the community--perhaps whether they are locals or cosmopolitans. Data on occupational backgrounds of Arkansas legislators is found in the <u>Arkansas Almanac</u>. An important factor that this source does not document, however, is party affiliation. There are probably not many, if any, Republican state legislators in Arkansas, but in such a one-party state, the location of minority party strength is one of the most interesting things to analyze. Other sources that may give information on residence and birth as well as other background data (including party) for state legislators are the <u>Directory of the Arkansas Legislature</u> and <u>Who is Who in the Oklahoma Legislature</u>.

The larger and more diverse pool of potential candidates may affect the method of candidate recruitment. That is, party may be a very significant source of candidate recruitment. Formal and informal groups may also encourage groups to run. If the rule is that recruitment comes through party organization, newcomers anxious for innovation and growth may have to recruit themselves (self-starters) or rely on informal groups. In a region controlled by locals, and especially in one-party areas, one would expect the majority party to wield extraordinary influence in recruiting candidates. In this case, where cosmopolitans were trying to attain office, other methods of recruitment, such as informal groups or self-recruitment, might tend to become more frequent. Of course, to obtain information on recruitment methods, interviews with legislators would be required. In a study of the Arkansas legislature where a random sample of 53 legislators was taken, the following results were obtained:

Method of Candidate Recruitment

	#	%
Self-recruitment	24	45.2
Formal groups	17	32.0
Informal groups	8	15.1
Party	4	7.3

Source: Donald Wells, in Lacy, op. cit., p. 12.

This appears to negate the hypothesis above. But this data was obtained at one point in time and does not show any trends that might exist in recruitment methods. To discern such changes, interviews or questionnaires would have to be employed at regular intervals over time.

Apart from "cosmopolitanization," the development of the Arkansas River may have some consequences for governmental structure in the area. The awareness of a need for proper land use will be heightened. This heightened awareness may be an inducement for the organization of some planning bodies or agencies. Governmental or quasi-governmental bodies such as sewer districts, water supply districts, drainage districts, etc., are examples of bodies that may be formed as a result of the river development. This may occur in part as a result of the growth of the region in population, etc. Another possible structural change that may come about partly as a function of growth is an increase in the use of city manager form of government. Other consequences to which growth contributed, of course, have been discussed above. The incidence of special districts or agencies and an increase in the number of city manager governments are two relatively concrete indicators of structural change that may occur as a by-product of growth initiated by the development of the Arkansas River. Data showing trends in the total number of local governments serving the two states since 1952 appear below:

Arkansas

	1967	1962	1957	1952
Total Local Govts.	1252	1208	1127	1089
School Districts	1402	1417	1423	1422
Counties	75	75	75	75
Municipalities	423	417	374	360
Special Dist.	352	299	254	231
Fire Protection	2	2	n.a.	n.a.
Highways	10	8	7	n.a.
Housing & Urban Renewal	66	11	10	n.a.
Drainage	105	102	98	n.a.
Flood Control	44	43	25	n.a.
Soil Conservation	77	76	74	n.a.
Sewerage	13	18	n.a.	n.a.
Utilities	33	36	n.a.	n.a.

Oklahoma

	1967	1962	1957	1952
Total Local Govts.	1773	1959	2331	2770
School Dist.	960	1225	1643	2100
Counties	77	77	77	77
Municipalities	522	533	506	499
School Dist.	214	124	105	94
Fire Protection	1	1	n.a.	n.a.
Housing & Urban Renewal	1	n.a.	n.a.	n.a.
Drainage	3	1	n.a.	n.a.
Flood Control	38	14	n.a.	n.a.
Irrigation, Water Conserv.	10	9	4	n.a.
Soil Conservation	90	88	86	n.a.
Parks & Recreation	1	n.a.	n.a.	n.a.
Sewerage	3	2	n.a.	n.a.
Utilities	64	7	n.a.	n.a.

Source: Census of Governments, 1967, 1962, 1957.

Data on the number of local governments including special districts is found in the Census of Governments. Data on the use of the city manager form of government can be found in a publication of the International City Managers' Association entitled Recent Council-Manager Developments and Directory of Council-Manager Cities and in the Municipal Year Book published also by the ICMA.

Finally, a less concrete but nevertheless significant impact of river development may be in the style and tone of political activity. Politics in the South has for many decades been of a "friends and neighbors" variety with personalities, local ties and emotional appeals carrying the greatest weight in deciding elections. This has changed to some extent already, but to predict that it will continue, or even if it does, that it is a result of some identifiable cause is very risky. Still, if the potential consequences that have been suggested above--particularly regarding the partial displacement of locals in the political structure by cosmopolitans and the emphasis on growth--do to some extent occur, it seems quite probable that as a by-product, the style of politics will become less personality and emotion-oriented and more issue-oriented. Evidence of such a trend would be somewhat more difficult to obtain, but a likely method would be content analysis of the statements and speeches of public officials for differences in campaign and other political appeals.

In allof these areas, the only methodology which seems practical is simple monitoring of the measures suggested in this section, with judgmental comparisons between river and off-river counties.

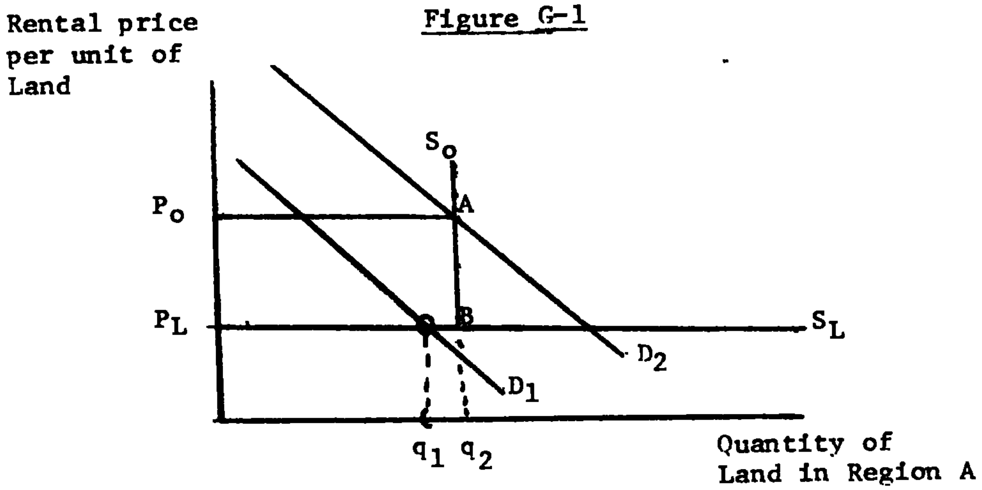
APPENDIX G

SOME ELEMENTS OF INTERREGIONAL TRADE THEORY

The theory of interregional trade is nothing more than a theory of general equilibrium which includes the existence of spatial immobilities. The degree of immobility of an economic object might be measured by the cost (say, in labor time expended) to move the object from one region to another. Thus, the cost of transporting say a coal mine from one region to another would be, for our purposes, infinite in which case we would say that the coal mine is perfectly immobile. In contrast, the cost of moving mined coal would be relatively low so mined coal can be said to possess a higher degree of mobility than a coal mine. As stated earlier, we will make the assumption that all resources, in the short-run, are perfectly immobile between regions but are perfectly mobile within each region. All produced goods are assumed to be mobile, the degree of immobility being measured by transport costs.

We will begin with an economy spread over two regions, and consider the problem of determining the economic conditions underlying interregional trade in a single industry, say oil. Suppose initially that just 1 of the regions (region A) has oil bearing deposits, and that only a fixed number of units of land contains oil. Further suppose that a fixed quantity of oil can be extracted from each unit of land per year, and that if the land is used for oil wells, it cannot simultaneously be used for anything else. Assume for convenience that agriculture is the only alternative use to which the land can be put. Figure G-1 illustrates the supply curve of all land in region A(S_L), and the supply curve of that land which is oil bearing (S_o). The price P_L is the rental price per unit of land that can be received by the owner of any of the land in the region if it is used for agriculture. That is, it is the rental price per unit of land for agriculture use. The supply curve S_L is shown to be perfectly elastic purely for convenience since that is not a necessary requirement.

Figure G-1



The figure also contains representations of two demand curves for oil bearing land, D_1 and D_2. These demands curves are, of course, derived from the demand curve for oil. If demand for oil bearing land is represented bv curve D_1, then obviously the equilibrium rental price of the land for oil use is P_L, the opportunity cost of the land for use in agriculture. Since oil bearing land is in excess supply, relative to demand D_1 it is not a scarce resource and the price for use of the oil bearing property is therefore zero. Competition among owners of the land will prevent the rental price from rising above P_L. If, however, demand for oil bearing land is represented by D_2, then the supply of oil bearing land is limited or scarce relative to demand. Oil companies will therefore be willing to pay a premium to owners of the oil bearing land so that the rental rate will rise to P_o. The rental price for use of land for agriculture will however remain at P_L. The difference $P_o - P_L$ is called the economic rent per unit of oil bearing land, which accrues to owners of oil bearing land.[1] The rectangle P_L P_o A B represents total rent to owners of oil bearing land. Notice that this rent is not the price charged for use of land. It is instead the price charged for the right to extract oil from the ground and to sell it.

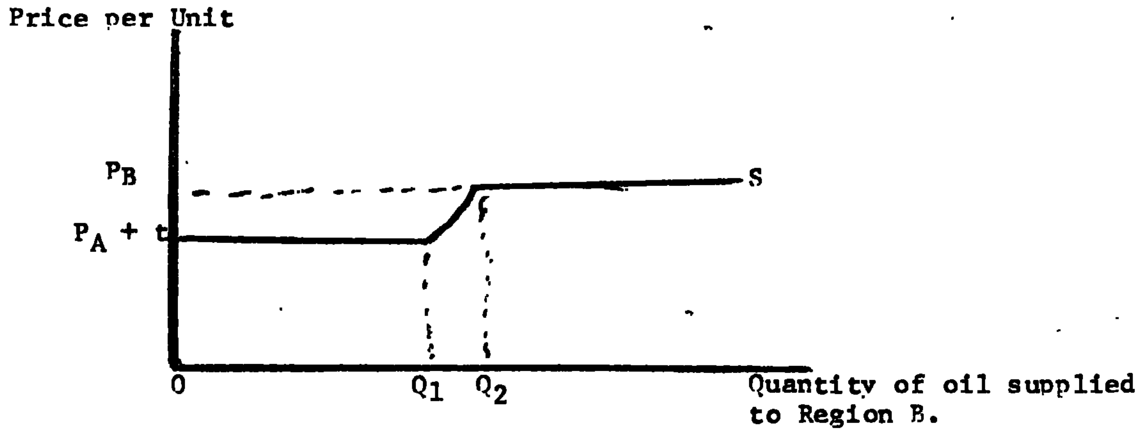
Introducing a second region into the analysis requires that consideration be given to spatial separation of resources and produced goods. As stated earlier, resources such as oil bearing land, are assumed to be perfectly immobile. In contrast, produced goods such as oil can be transported at a cost. Thus a user of oil in say region B would be willing to substitute a unit of oil produced in region A for a unit produced in region B only if the delivered price per unit from A is relatively lower. If production costs per unit are equal between the two regions, clearly region A oil will not be used in region B. If transport costs are zero, however, users of oil will be indifferent to the location of the source. Figure G-2 illustrates a supply curve of oil to region B. The rental price P_A is the opportunity cost of producing 1 unit of oil in region A, P_B is the same opportunity cost in B, and t is the transport cost per unit of oil from A to B.

It should be noted that the curve above represents the supply curve for produced oil and not for oil bearing land. Consequently, included in price P_A is not only land rental price P_L described in the previous diagram but also labor and capital costs of extracting the oil. As the curve is drawn, it is cheaper for region A to produce oil and to ship it to region B than for region B to attempt to produce it. At any delivered price between P_A + t and

---

[1]Later the term "quasi-rent" will also be used. The distinction between the two is that rent is a long-run return above opportunity cost while quasi-rent is a short-run return. We will use the two terms interchangably since the distinction is not important here.

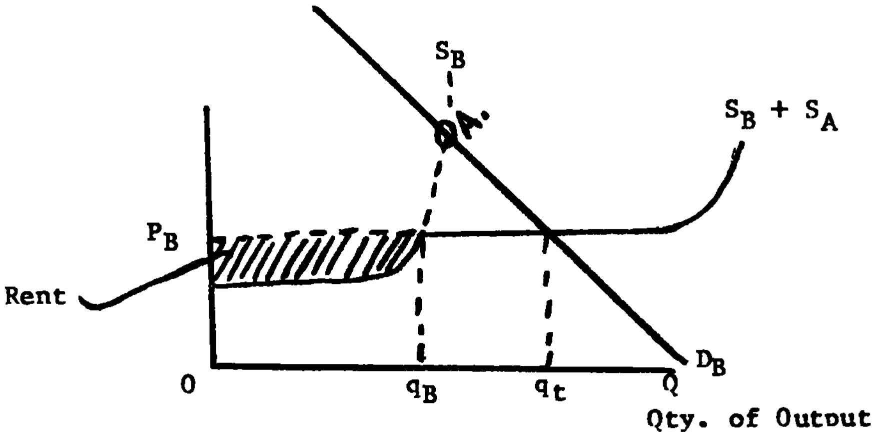
Figure G-2



P_B, region B produces nothing and region A produces and exports all of its oil to B. At output Q_1, the supply of some resource in region A used in producing the oil is being fully utilized, (e.g., the limitational resource might be the quantity of oil bearing land available to the region). Increased output beyond Q_1, say to some output between Q_1 and Q_2 reflects more intense utilization of the limitational resource. Other resources such as labor and capital are substituted for the oil bearing land. That is, if labor and capital are used more intensively in extracting the oil, then a larger output per unit of oil bearing land might be achieved. At price P_B, it becomes profitable for region B to begin producing oil. The supply curve, as drawn, is perfectly elastic at outputs beyond Q_2.

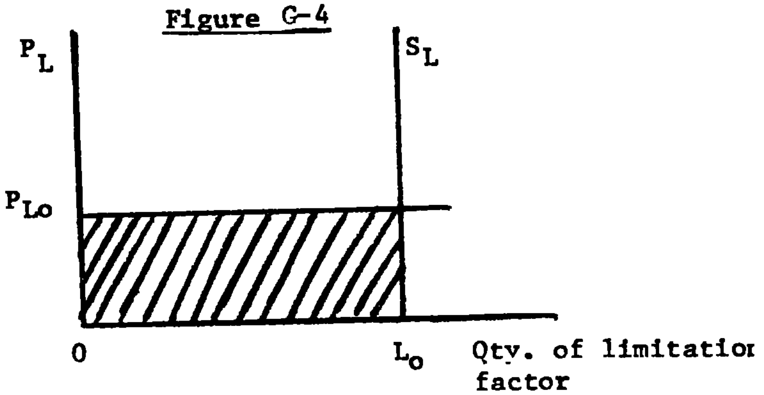
We can extend the analysis connected with figure G-2 by introducing a demand curve for region B. Hence, consider the following example in which all of the product produced in both regions is consumed in region B. Output produced by either region is assumed to be limited by regional resource endowment so that both regions produce some of the product. Suppose that the supply curves of all resource inputs but one entering into the production of the product are perfectly elastic, and that the one resource is fixed in quantity. Figures G-3 and G-4 illustrate the product supply curves for both region, demand curves, and also the limitational factor supply curve in region B.

Figure G-3



Product Supply and Demand in region B.

Figure G-4



Limitation factor in region B.

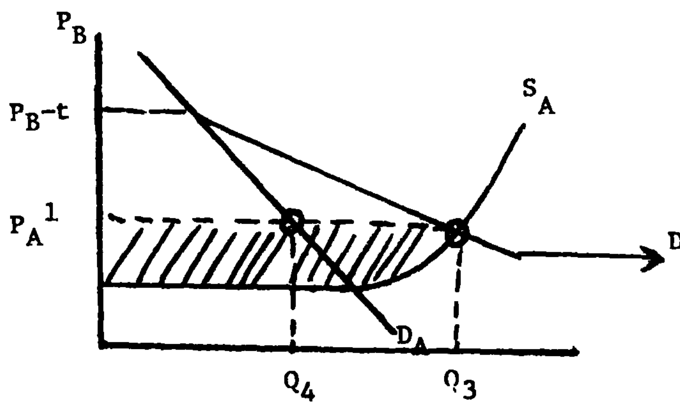
In Figure G-3, the equilibrium price and quantity is (P_B, q_t). The supply curve of the product in region B is S_B so that at price P_B, region B produces quantity q_B and region A produces $q_t - q_B$. Price P_B is determined by the production--plus--transport costs of the highest cost region. In Figure G-3, production plus transport costs of region A is P_B.

The shaded area in Figure G-3 above the supply curve S_B and below the price line P_B represents rent to owners of the limitational resource. This limitational resource can be interpreted as a short-run or a long-run constraint. If for example, it is a short-run constraint on capacity then individual firms will be earning a quasi-rent to the limitational capacity. In the long-run, the supply of capital is usually assumed to be perfectly elastic so that over time, existing firms will add to their capacity, and new firms will be induced to enter the industry. Output will expand until either a long-run limitational resource is encountered or else the lowest cost region produces all output for every region.

If Figure G-3 is interpreted as a long-run equilibrium, the limitational resource will usually be some nonreproducable resource (such as, for example, oil bearing land). Figure G-4 represents the supply of the limitational resource. It can similarly be interpreted as a short-run capacity constraint or a long-run resource constraint. In either case, the shaded area represents quasi-rent or rent imputed to it. The dollar value of the shaded area in Figure G-4 is equal to the dollar value of the area in Figure G-3.

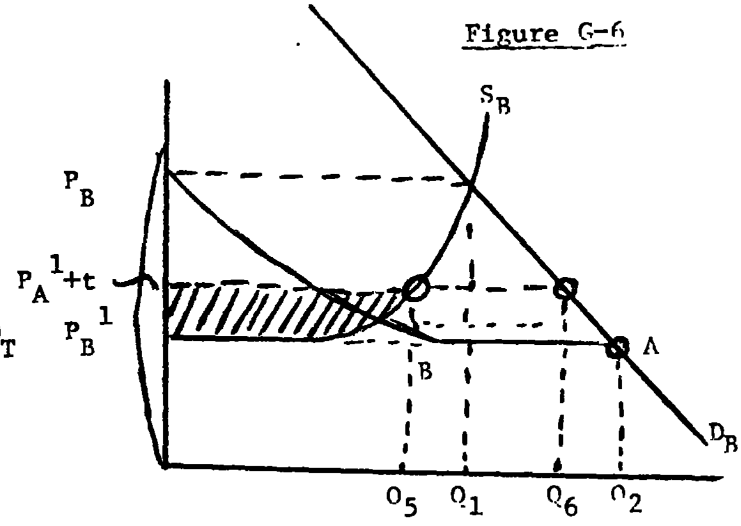
Extending the model, assume now that both regions demand and supply the product, and that both contain limitational factors. Figures G-5 and G-6 illustrate this case where we have arbituarily assumed that region A exports to region B.

Figure G-5



Region A

Figure G-6



Region B

Rent is received by producers in both regions. In Figure G-6 the demand curve for the product in region B, is D_B, and quantity supplied by region B is S_B. From these demand and supply curves, we can construct the derived demand curve P_BBA. This curve is defined by the difference between quantity demanded by region B and quantity supplied by region B at alternative prices. At price P_B, zero quantity will be demanded from region A because region B is supplying a sufficient quantity (Q_1) to meet demand. Alternatively, at price P_B, quantity demanded from region A is Q_2 because quantity supplied by region B is zero. The derived demand curve, P_BB_A in Figure G-6 is added to the demand curve D_A of region A, shown in Figure G-5. When the derived demand curve is transferred to Figure G-5, however, it must be lowered by a price t to account for transport costs. For example, a product of price P_B in region B must sell for only P_B - t in region A because transport cost from A to B add t dollars per unit to the price. Equilibrium price in region A is P_A^1 and total quantity produced in A is Q_3, $Q_3 - Q_4$ of which is exported to region B. Thus $Q_3 - Q_4 = Q_6 - Q_5$. Equilibrium price in region B is $P_A^1 + t$, and equilibrium quantity consumed by region B is Q_6. The shaded areas in both Figures constitute quasi-rents to owners of limitational factors.

The two region model above contains descriptions of most of the economic factors underlying interregional trade relationships in multiregion multiindustry contexts. Essentially, all that was said above was that if supply and demand curves by region, and transport costs, are specified, an equilibrium will emerge in which price of outputs, outputs, and trade pattern are determined by corresponding production plus transport costs of the highest cost region. The trade pattern which does emerge is caused by competition between firms and regions. This pattern is a minimum cost solution to producing the quantities that are produced. Any other regional pattern of production that is sufficient to satisfy the given quantities demanded will cost more. In this sense, competition brings about an economically most efficient solution. The interesting conclusion that costs are minimized carries over to any number of industries and regions. Equilibrium trade patterns, prices, and outputs are determined by the cost minimization process resulting from competition.

The equilibrium pattern of trade that results depends on limitational factors which determine conditions of supply. Owners of limitational factors receive quasi-rents imputed to those factors because they are scarce. These quasi-rents serve the economic function of providing an incentive to owners of factors to employ them in the use which generates the highest quasi-rent. Thus quasi-rents serve as a device for allocating scarce resources to their most efficient (i.e., highest paying) use. In the multiindustry, multiregion context, the set of quasi-rents serves as a guide to investors. Investors, searching for the highest return per dollar invested, will choose that opportunity which yields the highest stream of quasi-rents.

Since the quasi-rents are scarcity payments to scarce resources, the pattern of ownership of resources determines the distribution of income and hence the shape and level of demand curves. In our two region model, for simplicity, we ignored these effects. They could be included, however, but the model would become greatly complicated. Similarly, in the multiregion multiindustry case, exclusion of the relationship simplifies the model but at the expense of reducing the range of problems that can be answered. In any case, inclusion of these relationships does not substantially alter the conclusions regarding characteristics of the general equilibrium above.

The programming model of industrial location described in Part IV is a general equilibrium model that analyzes a multiregional economy with trade between regions. The purpose of this appendix is to describe the application of the model to an empirical problem. In the first part of this appendix a general methodology for studying such a problem is presented and then, an example following the steps of the general methodology is given.

Only a limited number of commodities—those sensitive to water (or perhaps rail) transportation are of interest, but even in this set only commodities for which the major ingredient resources used to produce a commodity should be located in the region. This is because resources are assumed perfectly mobile within a region but perfectly immobile between regions at least in the short-run version of the model.

Once a commodity has been selected for analysis the appropriate sets of regions must be defined. One set of regions is determined by the demand conditions of the chosen commodities; the other set, by the supply conditions. These two sets may or may not be coincident.

After the commodity and its producing and consuming regions defined statistics on demands, costs, and capacities must be collected. These figures are the input of the linear programming problem which solves for prices of commodities and limitational factors, outputs, and trade patterns. Quantities demanded can be observed simply from the regional distribution of purchases. The cost data are gathered next. These costs are for the short-run because the linear programming model solves for the specific capacities that exist at the time the impacts are being evaluated. Short-run costs may be calculated by the primary factor or value added approach. The first method involves decomposing the costs into labor, capital, and land costs. Total labor costs are equal to average product times average wage. For example, in the coal industry, they are average ton per man day times average wage. The average figures, which are easily available, are justified by the fixed coefficients assumed in the linear programming theory.

Capital costs cannot be computed this way, for the statistics usually are not available. Therefore, figures on supply costs, interests, and rents must be used.

If one knows the interest rate and the present value of the land, the land costs can be computed as shown in Part IV of the report. As indicated, present land values are normally recorded in the county assessors' offices. The value added approach is an alternative technique. Costs are acquired at various stages in producing a commodity. Adding these costs together will yield total costs.

Finally, transport costs are added to the costs calculated by either of the above methods. Transport costs are also divided into inventory, warehouse, and shipping costs. An example will show why these three factors are considered. Suppose coal is extracted in region A and shipped to region B by barge or train. Comparing shipping charges alone, it will certainly be less costly to ship by barge. However, barge rates are only low for large shipments, and it takes several days for these shipments to accumulate. Therefore, two additional costs are incurred. One, the coal producer forgoes a return on the money value of his output waiting idly in a warehouse. Two, he must pay the warehouse owner for storing the mine's output. Consequently, when deciding to ship by rail or water, the coal producer must weigh all the costs, and the model should include all of them.

Besides learning what shipping and storage costs are and computing inventory costs by the interest rate, a representative route between regions A and B must be drawn. Obviously, the transport costs along all possible routes cannot be determined, so some nodal point in the regions must be chosen. In region A, a metropolitan area or a point of extensive coal production can serve as the shipping point. Similarly, a city of concentrated demand can serve as the receiving point in B.

As specified in the paper, the investment function depends on the following: fixed costs, depreciation rates, and short-run profits. Items that would comprise the fixed cost statistics are plant and equipment purchases, research and surveying costs, and other capital costs peculiar to a particular industry. If depreciation rates cannot be found, they can be computed by devising a rule for depletion of the capital stock. To obtain short-run profits, when statistics are not available, requires solving the linear programming model twice. First, current data on demands, costs, and capacities are used to solve the programming problem for current prices, which includes profit figures. Then, these figures are put into the investment function along with fixed costs and depreciation rates to solve for capacity restrictions. Finally, the future capacity restrictions in conjunction with future demands and costs are fed into the second programming problem which solves for future prices, outputs, and trade patterns.

An example

In this section, an example will illustrate the general methodology proposed in the first part. The problem is to measure the impact of the Arkansas-Verdigris River Project on the Arkansas-Oklahoma regional economy. This project will effect a change in the transportation system and, consequently, in the transport rates and costs of production. This change will stimulate repercussions in the region under consideration, as well as in other regions. To determine the results of the impacts of the government project, the steps outlined would be followed and compared with actual industrial change to determine what share of total change could be attributed to investment in capacity stimulated by the project.

Coal and lumber are two of several commodities we might consider in an analysis of the river area. Geographically, coal is an ideal case commodity. Deposits sandwich the river from western Arkansas into eastern Oklahoma. Since coal is a bulky commodity, it is likely to be shipped by water in preference to current rail and truck shipments. That means the commodity is directly affected by the change in transportation. But, demand conditions also look favorable. Given growing interest in pollution control, the demand for high grade metallurgical coal is certain to rise. Oklahoma contains deposits of this scarce coal. Other resources, natural gas and oil, are relatively scarce when compared to coal and its vast reserves. Technology should permit substitution of coal for other energy sources soon. Coal men are very optimistic about this possibility despite threats of wider usage of nuclear power.

A linear programming study of the lumber industry by Holley[1] predicts the South will supply thirty percent of the nation's pine plywood by 1975. Because resources in northwestern United States are being depleted and because cost saving machinery has been introduced into logging, the South will be an able competitor for the Pacific Region, which is less favorably located. Arkansas is one of the regions producing lumber in Holley's interregional model. Additionally, this lumber is grown throughout the state with concentration of stock in the river area. Therefore, water transport seems feasible in this instance also.

As discussed in the report, other commodities would be added to lumber and coal, but since this Appendix does not perform an actual test, but only describes one, the two commodities illustrate the testing process adequately.

The regions for each of these two commodities are as follows:

For coal, the producing and consuming regions overlap. The Bureau of Mines and the Census Bureau collect their statistics employing the same geographical

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[1]Holley, D. L. "Potential Growth of the Southern Pine Plywood Industry," U.S. Department of Agriculture, Forest Research Paper SO-41, 1969.

boundaries. The regions are:

1. New England
2. Middle Atlantic
3. East North Central
4. West North Central
5. South Atlantic
6. East South Central
7. West South Central
8. Mountain
9. Pacific
10. Overseas

Holley's article contains a list of producing and consuming regions for lumber. The lumber industry is concentrated in a few areas, so the boundaries do not coincide for both sets of regions.

Production Regions	Consumption Regions	
Southern Pine Regions	Atlanta	Memphis
Washington	Birmingham	Miami
Oregon	Boston	Milwaukee
California	Buffalo	New Orleans
Idaho	Charlotte	New York
Montana	Chicago	Norfolk
Wyoming	Cincinnati	Oklahoma City
Colorado	Cleveland	Omaha
New Mexico	Columbus	Philadelphia
Arizona	Dallas	Phoenix
British Columbia	Denver	Pittsburgh
	Detroit	Portland
	Houston	St. Louis
	Huntington	St. Paul
	Indianapolis	Salt Lake City
	Jacksonville	San Antonio
	Kansas City	San Francisco
	Knoxville	Seattle
	Little Rock	Spokane
	Los Angeles	Tampa
	Louisville	Washington

It must be remembered that demands change over time as does capacity so that the demands in the model should be the weighted average over time, weighted by the regional distribution of outputs in each year of the total period of the impact analysis.

To calculate the costs of extracting coal, the primary factor approach is recommended. Labor costs are derived by multiplying the average ton per man day figures by the average wage. The former figures are found in the Bureau of Mines _Minerals' Yearbook_; while the latter figure is published by the Bureau of Labor Statistics.

The term capital encompasses a wide variety of items, and therefore, it is difficult to determine its portion of production costs. The Bureau of the Census publishes the _Census of Mineral Industries_, which contains information on capital expenditures for all mines in a particular district. Dividing total expenditures by the number of mines results in the average capital costs per mine for the region as a whole.

Still, there are some complications. For example, Arkansas and Oklahoma extract coal from both strip and underground mines. Unfortunately, the expenditures are aggregated for these two distinct operations. In addition, capital cost figures from the Census Bureau excludes rents, interests, and other items. While these data limitations are to be expected, they will have to be adjusted for by _ad hoc_ studies in the area.

Land costs have been discussed in the body of the report, and the bond rate of interest for the Arkansas-Oklahoma region should serve as the discount rate in the model.

Another approach to cost estimation is the value added method. Holley employs this technique to determine total lumber costs. The total costs are equal to logging costs, plywood, labor, and glue costs, and manufacturing costs. Land, labor, and capital costs are involved in all three stages of production. In some cases the value added approach will be more convenient than direct estimation.

No matter how the short-run costs are determined, however, the transport costs over a representative route must be added to them. Warehousing costs would have to be derived from surveys. The average shipment of tons of coal or board feet of logs along the route would yield a representative shipment size, and the value of such a shipment could then be discounted by the bond rate of interest to arrive at inventory costs.

Of course, there are alternative transport modes, namely rail and highway and the rates on these modes will not remain constant when the barges begin to compete for hauling commodities. In any event these modes could be incorporated into the model with some reformulation.

Lastly, the capacities are required for the empirical study. The investment function determines what these would have been on the basis of the project effect.

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13. ABSTRACT

This research was undertaken in an effort to develop a theoretical framework of an empirically feasible procedure for assessing the broad economic, social, political and environmental impact of the McClellan-Kerr Arkansas River Multiple Purpose Project.

The report presents a methodology for projecting the efficient location of water related industry via regional linear programming. The spatial general equilibrium approach allows an analysis of the without condition, generally intractable in expost analysis.

Methodology for analyzing other social, political and environmental impacts are advanced, with less empirical and comprehensive theoretical content. Yet the strategy of general equilibrium analysis is maintained.

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Spatial General Equilibrium Model						
Social Indicators						
Aspiration Levels						
Motivational Research						
Purgative Capability of River Swamps						
Land Acquisition Policies						
Political Indication						